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AERONAUTICS

Includes aeronautics (general); aerodynamics; air transportation and safety; aircraft communications and navigation; aircraft design, testing and performance; aircraft instrumentation; aircraft propulsion and power; aircraft stability and control; and research and support facilities (air).

For related information see also *Astronautics*.

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20 SPACECRAFT PROPULSION AND POWER N.A.

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For related information see also *07 Aircraft Propulsion and Power, 28 Propellants and Fuels, 44 Energy Production and Conversion,* and *15 Launch Vehicles and Space Vehicles.*

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Includes engineering (general); communications and radar; electronics and electrical engineering; fluid mechanics and heat transfer; instrumentation and photography; lasers and masers; mechanical engineering; quality assurance and reliability; and structural mechanics.

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Includes quantum mechanics; theoretical physics; and Bose and Fermi statistics.
For related information see also *25 Inorganic and Physical Chemistry* and *34 Fluid Mechanics and Heat Transfer.*

SOCIAL SCIENCES

Includes social sciences (general); administration and management; documentation and information science; economics and cost analysis; law, political science, and space policy; and urban technology and transportation.

80 SOCIAL SCIENCES (GENERAL) N.A.
Includes educational matters.

81 ADMINISTRATION AND MANAGEMENT 1260
Includes management planning and research.

82 DOCUMENTATION AND INFORMATION SCIENCE 1261
Includes information management; information storage and retrieval technology; technical writing; graphic arts; and micrography.
For computer documentation see *61 Computer Programming and Software.*

83 ECONOMICS AND COST ANALYSIS N.A.
Includes cost effectiveness studies.

84 LAW, POLITICAL SCIENCE AND SPACE POLICY N.A.
Includes NASA appropriation hearings; aviation law; space law and policy; international law; international cooperation; and patent policy.

85 URBAN TECHNOLOGY AND TRANSPORTATION 1262
Includes applications of space technology to urban problems; technology transfer; technology assessment; and surface and mass transportation.
For related information see *03 Air Transportation and Safety, 16 Space Transportation,* and *44 Energy Production and Conversion.*

SPACE SCIENCES

Includes space sciences (general); astronomy; astrophysics; lunar and planetary exploration; solar physics; and space radiation.
For related information see also *Geosciences.*

88 SPACE SCIENCES (GENERAL) N.A.

89 ASTRONOMY 1262
Includes radio, gamma-ray, and infrared astronomy; and astrometry.

90 ASTROPHYSICS 1263
Includes cosmology; celestial mechanics; space plasmas; and interstellar and interplanetary gases and dust.
For related information see also *75 Plasma Physics.*

91 LUNAR AND PLANETARY EXPLORATION 1263
Includes planetology; and manned and unmanned flights.
For spacecraft design or space stations see *18 Spacecraft Design, Testing and Performance.*

92 SOLAR PHYSICS 1263
Includes solar activity, solar flares, solar radiation and sunspots.
For related information see *93 Space Radiation.*

93 SPACE RADIATION 1264
Includes cosmic radiation; and inner and outer earth's radiation belts.
For biological effects of radiation see *52 Aerospace Medicine.* For theory see *73 Nuclear and High-Energy Physics.*

GENERAL

Includes aeronautical, astronautical, and space science related histories, biographies, and pertinent reports too broad for categorization; histories or broad overviews of NASA programs.

99 GENERAL 1265

Note: N.A. means that no abstracts were assigned to this category for this issue.

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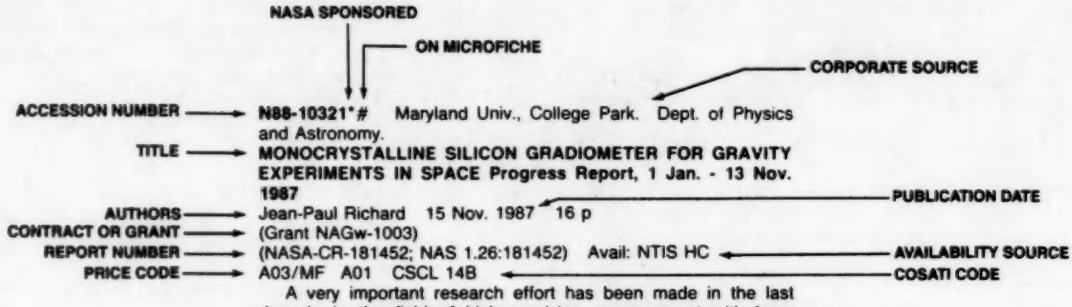
REPORT/ACCESSION NUMBER INDEX I-81

TYPICAL CITATION AND ABSTRACT



A very important research effort has been made in the last decade in the field of high precision measurement with laser instrumentation. The development of a space borne gradiometer operating at a high sensitivity level using laser measurement of the distance between proof mass over a short base line of order one meter is discussed. Two aspects of laser technology make it a promising tool for gradiometry measurements: quantum limited accuracy and absolute distance measurements. The quantum limit associated with laser instrumentation was formulated. The relevant quantum and classical sources of errors in laser measurements were reviewed and corresponding laser performance requirements for gradient measurements were evaluated. Some mechanical quality factor measurements were made on simple resonant monocrystalline silicon suspensions. It was discovered that the use of zero derivative restoring forces to position the gradiometer test masses will dramatically reduce the gradiometer temperature control requirements. A laser beam side injection scheme was discovered which permits rejection of common mode accelerations. These concepts are briefly discussed. Author

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Scientific and Technical Aerospace Reports

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01 AERONAUTICS (GENERAL)

N88-16624# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Systems and Logistics.

A MODEL FOR ESTIMATING DEPOT MAINTENANCE COSTS FOR AIR FORCE FIGHTER AND ATTACK AIRCRAFT M.S. Thesis

Michael P. Waker Sep. 1987 84 p

(AD-A187097; AFIT/GSM/LSQ/87S-36) Avail: NTIS HC A05/MF A01 CSCL 05C

The model developed in this study has two cost estimating relationships (CERs) for estimating depot maintenance costs in its two categories: depot maintenance cost per Primary Authorized Aircraft (PAA); and, depot maintenance cost per flying hour. The data source used for depot maintenance costs is the Weapon Systems Cost Retrieval System (WSCRS) as developed by HQ AFLC. The CERs developed used empty weight of fighter and attack aircraft to predict the cost of depot maintenance per PAA. For depot maintenance cost per flying hour, the variables used were combat radius, thrust-to-weight ratio, and empty weight. The study found that the F-111 was a significant outlier with respect to the data set, but even when included in the data base the F-111 enhanced the values of the statistics for the model and improved the ability of the model to predict. The relationship found for depot maintenance cost per PAA in the CER developed, was not as strong a predictor as was the CER developed for depot maintenance cost per flying hour. This conclusion agrees with previous studies that have tried to determine significant relationships between depot maintenance costs and those costs attributed to the number of PAA. GRA

N88-16625*# National Aeronautics and Space Administration, Washington, D.C.

NASA/ARMY ROTORCRAFT TECHNOLOGY. VOLUME 1: AERODYNAMICS, AND DYNAMICS AND AEROELASTICITY

Feb. 1988 537 p Conference held at Moffett Field, Calif., 17-19 Mar. 1987

(NASA-CP-2495-Vol-1; NAS 1.55:2495-Vol-1) Avail: NTIS HC A23/MF A01 CSCL 01B

The Conference Proceedings is a compilation of over 30 technical papers presented at this milestone event which reported on the advances in rotorcraft technical knowledge resulting from NASA, Army, and industry rotorcraft research programs over the last 5 to 10 years. The Conference brought together over 230 government, industry, and allied nation conferees to exchange technical information and hear invited technical papers by prominent NASA, Army, and industry researchers covering technology topics which included: aerodynamics, dynamics and elasticity, propulsion and drive systems, flight dynamics and control, acoustics, systems integration, and research aircraft. For individual titles, see N88-16626 through N88-16631.

N88-16626*# Army Aerostructures Directorate, Hampton, Va.

ACCOMPLISHMENTS AT NASA LANGLEY RESEARCH CENTER IN ROTORCRAFT AERODYNAMICS TECHNOLOGY

John C. Wilson *In* NASA, Washington, NASA/Army Rotorcraft Technoloology. Volume 1: Aerodynamics, and Dynamics and Aeroelasticity Feb. 1988 p 7-33 (For primary document see N88-16625 09-01)

Avail: NTIS HC A23/MF A01 CSCL 01B

In recent years, the development of aerodynamic technology for rotorcraft has continued successfully at NASA LaRC. Though the NASA Langley Research Center is not the lead NASA center in this area, the activity was continued due to facilities and individual capabilities which are recognized as contributing to helicopter research needs of industry and government. Noteworthy accomplishments which contribute to advancing the state of rotorcraft technology in the areas of rotor design, airfoil research, rotor aerodynamics, and rotor/fuselage interaction aerodynamics are described. Rotor designs were defihed for current helicopters and evaluated in wind tunnel testing. These designs have incorporated advanced airfoils defined analytically and also proven in wind tunnel tests. A laser velocimetry system has become a productive tool for experimental definition of rotor inflow/wake and is providing data for rotorcraft aerodynamic code validation. Author

N88-16627*# Army Aviation Systems Command, Moffett Field, Calif.

THE DEVELOPMENT OF CFD METHODS FOR ROTOR APPLICATIONS **c05**

F. X. Caradonna and W. J. McCroskey *In* NASA, Washington, NASA/Army Rotorcraft Technology. Volume 1: Aerodynamics, and Dynamics and Aeroelasticity Feb. 1988 p 34-65 (For primary document see N88-16625 09-01)

Avail: NTIS HC A23/MF A01 CSCL 01C

The optimum design of the advancing helicopter rotor for high-speed forward flight always involves a tradeoff between transonic and stall limitations. However, the preoccupation of the rotor industry was primarily concerned with stall until well into the 1970s. This emphasis on stall resulted from the prevalent use of low-solidity rotors with rather outdated airfoil sections. The use of cambered airfoil sections and higher-solidity rotors substantially reduced stall and revealed the advancing transonic flow to be a more persistent limitation to high-speed rotor performance. Work in this area was spurred not only by operational necessity but also by the development of a tool for the prediction of these flows (the method of computational fluid dynamics). The development of computational fluid dynamics for these rotor problems was a major Army and NASA achievement. This work is now being extended to other rotor flow problems. The developments are outlined. Author

N88-16628*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

A SUMMARY OF RECENT NASA/ARMY CONTRIBUTIONS TO ROTORCRAFT VIBRATIONS AND STRUCTURAL DYNAMICS TECHNOLOGY **c08**

Raymond G. Kvaternik, Felton D. Bartlett, Jr., and John H. Cline (Army Aerostructures Directorate, Hampton, Va.) *In* NASA, Washington, NASA/Army Rotorcraft Technology. Volume 1: Aerodynamics, and Dynamics and Aeroelasticity Feb. 1988 p 71-179 (For primary document see N88-16625 09-01)

Avail: NTIS HC A23/MF A01 CSCL 01C

The requirement for low vibrations has achieved the status of a critical design consideration in modern helicopters. There is now a recognized need to accour.t for vibrations during both the analytical and experimental phases of design. Research activities

in this area were both broad and varied and notable advances were made in recent years in the critical elements of the technology base needed to achieve the goal of a jet smooth ride. The purpose is to present an overview of accomplishments and current activities of govern and government-sponsored research in the area of rotorcraft vibrations and structural dynamics, focusing on NASA and Army contributions over the last decade or so. Specific topics addressed include: airframe finite-element modeling for static and dynamic analyses, analysis of coupled rotor-airframe vibrations, optimization of airframes subject to vibration constraints, active and passive control of vibrations in both the rotating and fixed systems, and integration of testing and analysis in such guises as modal analysis, system identification, structural modification, and vibratory loads measurement. Author

N88-16629*# Army Aviation Systems Command, Moffett Field, Calif.

A REVIEW OF RESEARCH IN ROTOR LOADS c05

William G. Bousman and Wayne R. Mantay (Army Aerostructures Directorate, Hampton, Va.) *In* NASA, Washington, NASA/Army Rotorcraft Technology. Volume 1: Aerodynamics, and Dynamics and Aeroelasticity Feb. 1988 p 180-311 (For primary document see N88-16625 09-01)

Avail: NTIS HC A23/MF A01 CSCL 01C

The research accomplished in the area of rotor loads over the last 13 to 14 years is reviewed. The start of the period examined is defined by the 1973 AGARD Milan conference and the 1974 hypothetical rotor comparison. The major emphasis of the review is research performed by the U.S. Army and NASA at their laboratories and/or by the industry under government contract. For the purpose of this review, two main topics are addressed: rotor loads prediction and means of rotor loads reduction. A limited discussion of research in gust loads and maneuver loads is included. In the area of rotor loads predictions, the major problem areas are reviewed including dynamic stall, wake induced flows, blade tip effects, fuselage induced effects, blade structural modeling, hub impedance, and solution methods. It is concluded that the capability to predict rotor loads has not significantly improved in this time frame. Future progress will require more extensive correlation of measurements and predictions to better understand the causes of the problems, and a recognition that differences between theory and measurement have multiple sources, yet must be treated as a whole. There is a need for high-quality data to support future research in rotor loads, but the resulting data base must not be seen as an end in itself. It will be useful only if it is integrated into firm long-range plans for the use of the data. Author

N88-16630*# Army Aviation Systems Command, Moffett Field, Calif.

COMPREHENSIVE ROTORCRAFT ANALYSIS METHODS c02

Wendell B. Stephens and Edward E. Austin (Army Research and Technology Labs., Fort Eustis, Va.) *In* NASA, Washington, NASA/Army Rotorcraft Technology. Volume 1: Aerodynamics, and Dynamics and Aeroelasticity Feb. 1988 p 312-352 (For primary document see N88-16625 09-01)

Avail: NTIS HC A23/MF A01 CSCL 01A

The development and application of comprehensive rotorcraft analysis methods in the field of rotorcraft technology are described. These large scale analyses and the resulting computer programs are intended to treat the complex aeromechanical phenomena that describe the behavior of rotorcraft. They may be used to predict rotor aerodynamics, acoustic, performance, stability and control, handling qualities, loads and vibrations, structures, dynamics, and aeroelastic stability characteristics for a variety of applications including research, preliminary and detail design, and evaluation and treatment of field problems. The principal comprehensive methods developed or under development in recent years and generally available to the rotorcraft community because of US Army Aviation Research and Technology Activity (ARTA) sponsorship of all or part of the software systems are the Rotorcraft Flight Simulation (C81), Dynamic System Coupler (DYSCO), Coupled Rotor/Airframe Vibration Analysis Program (SIMVIB), Comprehensive Analytical Model of Rotorcraft Aerodynamics and Dynamics (CAMRAD), General Rotorcraft Aeromechanical Stability Program (GRASP), and Second Generation Comprehensive Helicopter Analysis System (2GCHAS). Author

N88-16631*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

ROTORCRAFT AEROELASTIC STABILITY c08

Robert A. Ormiston, William G. Warmbrodt, Dewey H. Hodges, and David A. Peters (Georgia Inst. of Tech., Atlanta.) *In* NASA, Washington, NASA/Army Rotorcraft Technology. Volume 1: Aerodynamics, and Dynamics and Aeroelasticity Feb. 1988 p 353-529 (For primary document see N88-16625 09-01)

Avail: NTIS HC A23/MF A01 CSCL 01C

Theoretical and experimental developments in the aeroelastic and aeromechanical stability of helicopters and tilt-rotor aircraft are addressed. Included are the underlying nonlinear structural mechanics of slender rotating beams, necessary for accurate modeling of elastic cantilever rotor blades, and the development of dynamic inflow, an unsteady aerodynamic theory for low-frequency aeroelastic stability applications. Analytical treatment of isolated rotor stability in hover and forward flight, coupled rotor-fuselage stability in hover and forward flight, and analysis of tilt-rotor dynamic stability are considered. Results of parametric investigations of system behavior are presented, and correlation between theoretical results and experimental data from small and large scale wind tunnel and flight testing are discussed. Author

N88-16632*# National Aeronautics and Space Administration, Washington, D.C.

NASA/ARMY ROTORCRAFT TECHNOLOGY. VOLUME 2: MATERIALS AND STRUCTURES, PROPULSION AND DRIVE SYSTEMS, FLIGHT DYNAMICS AND CONTROL, AND ACOUSTICS

Feb. 1988 587 p Conference held at Moffett Field, Calif., 17-19 Mar. 1987

(NASA-CP-2495-Vol-2; NAS 1.55:2495-Vol-2) Avail: NTIS HC A25/MF A01 CSCL 01B

The Conference Proceedings is a compilation of over 30 technical papers presented which report on the advances in rotorcraft technical knowledge resulting from NASA, Army, and industry research programs over the last 5 to 10 years. Topics addressed in this volume include: materials and structures; propulsion and drive systems; flight dynamics and control; and acoustics. For individual titles, see N88-16633 through N88-16649.

N88-16633*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

REVIEW OF FATIGUE AND FRACTURE RESEARCH AT NASA LANGLEY RESEARCH CENTER c39

Richard A. Everett, Jr. *In* NASA, Washington, NASA/Army Rotorcraft Technology. Volume 2: Materials and Structures, Propulsion and Drive Systems, Flight Dynamics and Control, and Acoustics Feb. 1988 p 535-572 (For primary document see N88-16632 09-01)

Avail: NTIS HC A25/MF A01 CSCL 20K

Most dynamic components in helicopters are designed with a safe-life constant-amplitude testing approach that has not changed in many years. In contrast, the fatigue methodology in other industries has advanced significantly in the last two decades. Recent research at the NASA Langley Research Center and the U.S. Army Aerostructures Directorate at Langley are reviewed relative to fatigue and fracture design methodology for metallic components. Most of the Langley research was directed towards the damage tolerance design approach, but some work was done that is applicable to the safe-life approach. In the areas of testing, damage tolerance concepts are concentrating on the small-crack effect in crack growth and measurement of crack opening stresses. Tests were conducted to determine the effects of a machining scratch on the fatigue life of a high strength steel. In the area of analysis, work was concentrated on developing a crack closure model that will predict fatigue life under spectrum loading for several

different metal alloys including a high strength steel that is often used in the dynamic components of helicopters. Work is also continuing in developing a three-dimensional, finite-element stress analysis for cracked and uncracked isotropic and anisotropic structures. A numerical technique for solving simultaneous equations called the multigrid method is being pursued to enhance the solution schemes in both the finite-element analysis and the boundary element analysis. Finally, a fracture mechanics project involving an elastic-plastic finite element analysis of J-resistance curve is also being pursued. Author

N88-16634*# Army Research and Technology Labs., Fort Eustis, Va. Aerostructures Directorate.

DELAMINATION DURABILITY OF COMPOSITE MATERIALS FOR ROTORCRAFT c24

T. Kevin OBrien *In* NASA, Washington, NASA/Army Rotorcraft Technology. Volume 2: Materials and Structures, Propulsion and Drive Systems, Flight Dynamics and Control, and Acoustics Feb. 1988 p 573-605 (For primary document see N88-16632 09-01)

Avail: NTIS HC A25/MF A01 CSCL 11D

Delamination is the most commonly observed failure mode in composite rotorcraft dynamic components. Although delamination may not cause immediate failure of the composite part, it often precipitates component repair or replacement, which inhibits fleet readiness, and results in increased life cycle costs. A fracture mechanics approach for analyzing, characterizing, and designing against delamination will be outlined. Examples of delamination problems will be illustrated where the strain energy release rate associated with delamination growth was found to be a useful generic parameter, independent of thickness, layup, and delamination source, for characterizing delamination failure. Several analysis techniques for calculating strain energy release rates for delamination from a variety of sources will be outlined. Current efforts to develop ASTM standard test methods for measuring interlaminar fracture toughness and developing delamination failure criteria will be reviewed. A technique for quantifying delamination durability due to cyclic loading will be presented. The use of this technique for predicting fatigue life of composite laminates and developing a fatigue design philosophy for composite structural components will be reviewed. Author

N88-16635*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

HELICOPTER CRASHWORTHINESS RESEARCH PROGRAM c03

Gary L. Farley, Richard L. Boitnott (Army Research and Technology Labs., Fort Eustis, Va.), and Huey D. Carden *In* NASA, Washington, NASA/Army Rotorcraft Technology. Volume 2: Materials and Structures, Propulsion and Drive Systems, Flight Dynamics and Control, and Acoustics Feb. 1988 p 606-655 (For primary document see N88-16632 09-01)

Avail: NTIS HC A25/MF A01 CSCL 01C

Results are presented from the U.S. Army-Aerostructures Directorate/NASA-Langley Research Center joint research program on helicopter crashworthiness. Through the on-going research program an in-depth understanding was developed on the cause/effect relationships between material and architectural variables and the energy-absorption capability of composite material and structure. Composite materials were found to be efficient energy absorbers. Graphite/epoxy subfloor structures were more efficient energy absorbers than comparable structures fabricated from Kevlar or aluminum. An accurate method predicting the energy-absorption capability of beams was developed. Author

N88-16636*# Army Research and Technology Labs., Fort Eustis, Va. Aviation Applied Technology Directorate.

ADVANCED COMPOSITE AIRFRAME PROGRAM: TODAY'S TECHNOLOGY c05

Danny E. Good and L. Thomas Mazza *In* NASA, Washington, NASA/Army Rotorcraft Technology. Volume 2: Materials and Structures, Propulsion and Drive Systems, Flight Dynamics and Control, and Acoustics Feb. 1988 p 656-678 (For primary document see N88-16632 09-01)

Avail: NTIS HC A25/MF A01 CSCL 01C

The Advanced Composite Airframe Program (ACAP) was undertaken to demonstrate the advantages of the application of advanced composite materials and structural design concepts to the airframe structure on helicopters designed to stringent military requirements. The primary goals of the program were the reduction of airframe production costs and airframe weight by 17 and 22 percent respectively. The ACAP effort consisted of a preliminary design phase, detail design, and design support testing, full-scale fabrication, laboratory testing, and a ground/flight test demonstration. Since the completion of the flight test demonstration programs follow-on efforts were initiated to more fully evaluate a variety of military characteristics of the composite airframe structures developed under the original ACAP advanced development contracts. An overview of the ACAP program is provided and some of the design features, design support testing, manufacturing approaches, and the results of the flight test evaluation, as well as, an overview of Militarization Test and Evaluation efforts are described. Author

N88-16637*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

TECHNOLOGY DEVELOPMENTS FOR A COMPOUND CYCLE ENGINE c07

George A. Bobula, William T. Wintucky, and J. G. Castor (Garrett Turbine Engine Co., Phoenix, Ariz.) *In* NASA, Washington, NASA/Army Rotorcraft Technology. Volume 2: Materials and Structures, Propulsion and Drive Systems, Flight Dynamics and Control, and Acoustics Feb. 1988 p 683-697 (For primary document see N88-16632 09-01)

Avail: NTIS HC A25/MF A01 CSCL 21E

The Compound Cycle Engine (CCE) is a highly turbocharged, power compounded power plant which combines the light weight pressure rise capability of a gas turbine with the high efficiency of a diesel. When optimized for a rotorcraft, the CCE will reduce fuel burned for a typical 2 hour (plus 30 min reserve) mission by 30 to 40 percent when compared to a conventional advanced technology gas turbine. The CCE can provide a 50 percent increase in range-payload product on this mission. Results of recent activities in a program to establish the technology base for a CCE are presented. The objective of this program is to research and develop those critical technologies which are necessary for the demonstration of a multicylinder diesel core in the early 1990s. A major accomplishment was the initial screening and identification of a lubricant which has potential for meeting the material wear rate limits of the application. An in-situ wear measurement system also was developed to provide accurate, readily obtainable, real time measurements of ring and liner wear. Wear data, from early single cylinder engine tests, are presented to show correlation of the in-situ measurements and the system's utility in determining parametric wear trends. A plan to demonstrate a compound cycle engine by the mid 1990s is included. Author

N88-16638*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

SMALL GAS TURBINE ENGINE TECHNOLOGY c07

Richard W. Niedzwiecki and Peter L. Meitner (Army Research and Technology Labs., Cleveland, Ohio.) *In* NASA, Washington, NASA/Army Rotorcraft Technology. Volume 2: Materials and Structures, Propulsion and Drive Systems, Flight Dynamics and Control, and Acoustics Feb. 1988 p 698-736 (For primary document see N88-16632 09-01)

Avail: NTIS HC A25/MF A01 CSCL 21E

Performance of small gas turbine engines in the 250 to 1,000 horsepower size range is significantly lower than that of large engines. Engines of this size are typically used in rotorcraft, commutercraft, general aviation, and cruise missile applications. Principal reasons for the lower efficiencies of a smaller engine are well known: component efficients are lower by as much as 8 to 10 percentage points because of size effects. Small engines are designed for lower cycle pressures and temperatures because of smaller blading and cooling limitations. The highly developed

analytical and manufacturing techniques evolved for large engines are not directly transferrable to small engines. Thus, it was recognized that a focused effort addressing technologies for small engies was needed and could significantly impact their performance. Recently, in-house and contract studies were undertaken at the NASA Lewis Research Center to identify advanced engine cycle and component requirements for substantial performance improvement of small gas turbines for projected year 2000 applications. The results of both in-house research and contract studies are presented. In summary, projected fuel savings of 22 to 42 percent could be obtained. Accompanying direct operating cost reductions of 11 to 17 percent, depending on fuel cost, were also estimated. High payoff technologies are identified for all engine applications, and recent results of experimental research to evolve the high payoff technologies are described.
Author

N88-16639*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
THE CONVERTIBLE ENGINE: A DUAL-MODE PROPULSION SYSTEM c07
Jack G. McArdle *In* NASA, Washington, NASA/Army Rotorcraft Technology. Volume 2: Materials and Structures, Propulsion and Drive Systems, Flight Dynamics and Control, and Acoustics Feb. 1988 p 737-768 (For primary document see N88-16632 09-01)
Avail: NTIS HC A25/MF A01 CSCL 21E

A variable inlet guide vane (VIGV) convertible engine that could be used to power future high-speed rotorcraft was tested on an outdoor stand. The engine ran stably and smoothly in the turbofan, turboshaft, and dual (combined fan and shaft) power modes. In the turbofan mode with the VIGV open, fuel consumption was comparable to that of a conventional turbofan engine. In the turboshaft mode with the VIGV closed, fuel consumption was higher than that of present turboshaft engines because power was wasted in churning fan-tip air flow. In dynamic performance tests with a specially built digital engine control and using a waterbrake dynamometer for shaft load, the engine responded effectively to large steps in thrust command and shaft torque. Previous mission analyses of a conceptual X-wing rotorcraft capable of 400-knot cruise speed were revised to account for more fan-tip churning power loss that was originally estimated. The calculations confirm that using convertible engines rather than separate life and cruise engines would result in a smaller, lighter craft with lower fuel use and direct operating cost.
Author

N88-16640*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
RESULTS OF NASA/ARMY TRANSMISSION RESEARCH c07
John J. Coy (Army Research and Technology Labs., Cleveland, Ohio.), Dennis P. Townsend, and Harold H. Coe *In* NASA, Washington, NASA/Army Rotorcraft Technology. Volume 2: Materials and Structures, Propulsion and Drive Systems, Flight Dynamics and Control, and Acoustics Feb. 1988 p 769-801 (For primary document see N88-16632 09-01)
Avail: NTIS HC A25/MF A01 CSCL 21E

Since 1970 the NASA Lewis Research Center and the U.S. Army Aviation Systems Command have shared an interest in advancing the technology for helicopter propulsion systems. In particular, that portion of the program that applies to the drive train and its various mechanical components are outlined. The major goals of the program were (and continue to be) to increase the life, reliability, and maintainability, reduce the weight, noise, and vibration, and maintain the relatively high mechanical efficiency of the gear train. Major historical milestones are reviewed, significant advances in technology for bearings, gears, and transmissions are discussed, and the outlook for the future is presented. The reference list is comprehensive.
Author

N88-16641*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
NASA'S ROTORCRAFT ICING RESEARCH PROGRAM c03
Robert J. Shaw, John J. Reinmann, and Thomas L. Miller (Sverdrup Technology, Inc., Cleveland, Ohio.) *In* NASA, Washington, NASA/Army Rotorcraft Technology. Volume 2: Materials and Structures, Propulsion and Drive Systems, Flight Dynamics and Control, and Acoustics Feb. 1988 p 802-832 (For primary document see N88-16632 09-01)
Avail: NTIS HC A25/MF A01 CSCL 01C

The objective of the NASA aircraft icing research program is to develop and make available icing technology to support the needs and requirements of industry for all weather aircraft designs. While a majority of the technology being developed is viewed to be generic (i.e., appropriate to all vehicle classes), vehicle specific emphasis is being placed on the helicopter due to its unique icing problems. In particular, some of the considerations for rotorcraft icing are indicated. The NASA icing research program emphasizes technology development in two key areas: ice protection concepts and icing simulation (analytical and experimental). The NASA research efforts related to rotorcraft icing in these two technology areas will be reviewed.
Author

N88-16642*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
HELICOPTER MATHEMATICAL MODELS AND CONTROL LAW DEVELOPMENT FOR HANDLING QUALITIES RESEARCH c08
Robert T. N. Chen, J. Victor Lebacqz, Edwin W. Aiken, and Mark B. Tischler (Army Aviation Systems Command, Moffett Field, Calif.) *In* NASA, Washington, NASA/Army Rotorcraft Technology. Volume 2: Material and Structures, Propulsion and Drive Systems, Flight Dynamics and Control, and Acoustics Feb. 1988 p 837-899 (For primary document see N88-16632 09-01)
Avail: NTIS HC A25/MF A01 CSCL 01C

Progress made in joint NASA/Army research concerning rotorcraft flight-dynamics modeling, design methodologies for rotorcraft flight-control laws, and rotorcraft parameter identification is reviewed. Research into these interactive disciplines is needed to develop the analytical tools necessary to conduct flying qualities investigations using both the ground-based and in-flight simulators, and to permit an efficient means of performing flight test evaluation of rotorcraft flying qualities for specification compliance. The need for the research is particularly acute for rotorcraft because of their mathematical complexity, high order dynamic characteristics, and demanding mission requirements. The research in rotorcraft flight-dynamics modeling is pursued along two general directions: generic nonlinear models and nonlinear models for specific rotorcraft. In addition, linear models are generated that extend their utilization from 1-g flight to high-g maneuvers and expand their frequency range of validity for the design analysis of high-gain flight control systems. A variety of methods ranging from classical frequency-domain approaches to modern time-domain control methodology that are used in the design of rotorcraft flight control laws is reviewed. Also reviewed is a study conducted to investigate the design details associated with high-gain, digital flight control systems for combat rotorcraft. Parameter identification techniques developed for rotorcraft applications are reviewed.
Author

N88-16643*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ROTORCRAFT FLIGHT-PROPULSION CONTROL INTEGRATION c08
James R. Mihaloew, Mark G. Ballin, and D. G. C. Ruttledge (Sikorsky Aircraft, Stratford, Conn.) *In* NASA, Washington, NASA/Army Rotorcraft Technology. Volume 2: Materials and Structures, Propulsion and Drive Systems, Flight Dynamics and Control, and Acoustics Feb. 1988 p 900-928 (For primary document see N88-16632 09-01)
Avail: NTIS HC A25/MF A01 CSCL 01C

The NASA Ames and Lewis Research Centers, in conjunction with the Army Research and Technology Laboratories have initiated and completed, in part, a joint research program focused on improving the performance, maneuverability, and operating characteristics of rotorcraft by integrating the flight and propulsion controls. The background of the program, its supporting programs, its goals and objectives, and an approach to accomplish them are discussed. Results of the modern control governor design of

the T700 and the Rotorcraft Integrated Flight-Propulsion Control Study, which were key elements of the program, are also presented. Author

N88-16644*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
HELICOPTER HUMAN FACTORS RESEARCH c54
David C. Nagel and Sandra G. Hart *In* NASA, Washington, NASA/Army Rotorcraft Technology. Volume 2: Materials and Structures, Propulsion and Drive Systems, Flight Dynamics and Control, and Acoustics Feb. 1988 p 929-947 (For primary document see N88-16632 09-01)
Avail: NTIS HC A25/MF A01 CSCL 05H

Helicopter flight is among the most demanding of all human-machine integrations. The inherent manual control complexities of rotorcraft are made even more challenging by the small margin for error created in certain operations, such as nap-of-the-Earth (NOE) flight, by the proximity of the terrain. Accident data recount numerous examples of unintended conflict between helicopters and terrain and attest to the perceptual and control difficulties associated with low altitude flight tasks. Ames Research Center, in cooperation with the U.S. Army Aeroflightdynamics Directorate, has initiated an ambitious research program aimed at increasing safety margins for both civilian and military rotorcraft operations. The program is broad, fundamental, and focused on the development of scientific understandings and technological countermeasures. Research being conducted in several areas is reviewed: workload assessment, prediction, and measure validation; development of advanced displays and effective pilot/automation interfaces; identification of visual cues necessary for low-level, low-visibility flight and modeling of visual flight-path control; and pilot training. Author

N88-16645*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
ROTORCRAFT HANDLING-QUALITIES DESIGN CRITERIA DEVELOPMENT c08
Edwin W. Aiken, J. Victor Lebacqz, Robert T. N. Chen, and David L. Key (Army Aviation Systems Command, Moffett Field, Calif.) *In* NASA, Washington, NASA/Army Rotorcraft Technology. Volume 2: Materials and Structures, Propulsion and Drive Systems, Flight Dynamics and Control, and Acoustics Feb. 1988 p 948-998 (For primary document see N88-16632 09-01)
Avail: NTIS HC A25/MF A01 CSCL 01C

Joint NASA/Army efforts at the Ames Research Center to develop rotorcraft handling-qualities design criteria began in earnest in 1975. Notable results were the UH-1H VSTOLAND variable stability helicopter, the VFA-2 camera-and-terrain-board simulator visual system, and the generic helicopter real-time mathematical model, ARMCOP. An initial series of handling-qualities studies was conducted to assess the effects of rotor design parameters, interaxis coupling, and various levels of stability and control augmentation. The ability to conduct in-flight handling-qualities research was enhanced by the development of the NASA/Army CH-47 variable-stability helicopter. Research programs conducted using this vehicle include vertical-response investigations, hover augmentation systems, and the effects of control-force characteristics. The handling-qualities data base was judged to be sufficient to allow an update of the military helicopter handling-qualities specification, MIL-H-8501. These efforts, including not only the in-house experimental work but also contracted research and collaborative programs performed under the auspices of various international agreements. The report concludes by reviewing the topics that are currently most in need of work, and the plans for addressing these topics. B.G.

N88-16646*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
RECENT LANGLEY HELICOPTER ACOUSTICS CONTRIBUTIONS c71
Homer G. Morgan, S. P. Pao, and C. A. Powell *In* NASA, Washington, NASA/Army Rotorcraft Technology. Volume 2: Materials and Structures, Propulsion and Drive Systems, Flight Dynamics and Control, and Acoustics Feb. 1988 p 1003-1044 (For primary document see N88-16632 09-01)
Avail: NTIS HC A25/MF A01 CSCL 20A

The helicopter acoustics program at NASA Langley has included technology for elements of noise control ranging from sources of noise to receivers of noise. The scope of Langley contributions for about the last decade is discussed. Specifically, the resolution of two certification noise quantification issues by subjective acoustics research, the development status of the helicopter system noise prediction program ROTONET are reviewed and the highlights from research on blade rotational, broadband, and blade vortex interaction noise sources are presented. Finally, research contributions on helicopter cabin (or interior) noise control are presented. A bibliography of publications from the Langley helicopter acoustics program for the past 10 years is included. Author

N88-16647*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
IDENTIFICATION AND PROPOSED CONTROL OF HELICOPTER TRANSMISSION NOISE AT THE SOURCE c08
John J. Coy, Robert F. Handschuh, David G. Lewicki (Army Research and Technology Labs., Cleveland, Ohio.), Ronald G. Huff, Eugene A. Krejsa, and Allan M. Karchmer *In* NASA, Washington, NASA/Army Rotorcraft Technology. Volume 2: Materials and Structures, Propulsion and Drive Systems, Flight Dynamics and Control, and Acoustics Feb. 1988 p 1045-1065 Previously announced as N87-16816 (For primary document see N88-16632 09-01)
Avail: NTIS HC A25/MF A01 CSCL 01C

Helicopter cabin interiors require noise treatment which is expensive and adds weight. The gears inside the main power transmission are major sources of cabin noise. Work conducted by the NASA Lewis Research Center in measuring cabin interior noise and in relating the noise spectrum to the gear vibration of the Army OH-58 helicopter is described. Flight test data indicate that the planetary gear train is a major source of cabin noise and that other low frequency sources are present that could dominate the cabin noise. Companion vibration measurements were made in a transmission test stand, revealing that the single largest contributor to the transmission vibration was the spiral bevel gear mesh. The current understanding of the nature and causes of gear and transmission noise is discussed. It is believed that the kinematical errors of the gear mesh have a strong influence on that noise. The completed NASA/Army sponsored research that applies to transmission noise reduction is summarized. The continuing research program is also reviewed. Author

N88-16648*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
A DECADE OF AEROACOUSTIC RESEARCH AT NASA AMES RESEARCH CENTER c71
Frederic H. Schmitz, M. Mosher, Cahit Kitaplioglu, J. Cross, and I. Chang *In* NASA, Washington, NASA/Army Rotorcraft Technology. Volume 2: Materials and Structures, Propulsion and Drive Systems, Flight Dynamics and Control, and Acoustics Feb. 1988 p 1066-1090 (For primary document see N88-16632 09-01)
Avail: NTIS HC A25/MF A01 CSCL 20A

The rotorcraft aeroacoustic research accomplishments of the past decade at Ames Research Center are reviewed. These include an extensive sequence of flight, ground, and wind tunnel tests that have utilized the facilities to guide and pioneer theoretical research. Many of these experiments were of benchmark quality. The experiments were used to isolate the inadequacies of linear theory in high-speed impulsive noise research, have led to the development of theoretical approaches, and have guided the emerging discipline of computational fluid dynamics to rotorcraft aeroacoustic problems. Author

N88-16649*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
AEROACOUSTIC RESEARCH PROGRAMS AT THE ARMY AVIATION RESEARCH AND TECHNOLOGY ACTIVITY c71

Yung H. Yu, Fredric H. Schmitz, and H. Andrew Morse (Army Aviation Systems Command, Moffett Field, Calif.) *In* NASA, Washington, NASA/Army Rotorcraft Technology. Volume 2: Materials and Structures, Propulsion and Drive Systems, Flight Dynamics and Control, and Acoustics Feb. 1988 p 1091-1113 (For primary document see N88-16632 09-01)
Avail: NTIS HC A25/MF A01 CSCL 20A

The Army rotorcraft aeroacoustic programs are reviewed, highlighting the theoretical and experimental progress made by Army researchers in the physical understanding of helicopter impulsive noise. The two impulsive noise sources addressed over this past decade are high-speed impulsive noise and blade-vortex interaction noise, both of which have had and will continue to have an increasing influence on Army rotorcraft design and operations. The advancements discussed are in the areas of in-flight data acquisition techniques, small-scale-model tests in wind tunnels, holographic interferometry/tomographic techniques, and the expanding capabilities of computational fluid dynamics in rotorcraft acoustic problems. Current theoretical prediction methods are compared with experimental data, and parameters that govern model scaling are established. The very successful cooperative efforts between the Army, NASA, and industry are also addressed Author

N88-16650*# National Aeronautics and Space Administration, Washington, D.C.
NASA/ARMY ROTORCRAFT TECHNOLOGY. VOLUME 3: SYSTEMS INTEGRATION, RESEARCH AIRCRAFT, AND INDUSTRY
Feb. 1988 387 p Conference held at Moffett Field, Calif., 17-19 Mar. 1987
(NASA-CP-2495-Vol-3; NAS 1.55:2495-Vol-3) Avail: NTIS HC A17/MF A01 CSCL 01B

This is part 3 of the conference proceedings on rotorcraft technology. This volume is divided into areas on systems integration, research aircraft, and industry. Representative titles from each area are: system analysis in rotorcraft design, the past decade; rotorcraft flight research with emphasis on rotor systems; and an overview of key technology thrusts at Bell Helicopter Textron. For individual titles, see N88-16651 through N88-16660.

N88-16651*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
STATUS OF NASA/ARMY ROTORCRAFT RESEARCH AND DEVELOPMENT PILOTED FLIGHT SIMULATION c09
Gregory W. Condon and Terrence D. Gossett (Army Aviation Systems Command, Moffett Field, Calif.) *In* NASA, Washington, NASA/Army Rotorcraft Technology. Volume 3: Systems Integration, Research Aircraft, and Industry Feb. 1988 p 1119-1153 (For primary document see N88-16650 09-01)
Avail: NTIS HC A17/MF A01 CSCL 14B

The status of the major NASA/Army capabilities in piloted rotorcraft flight simulation is reviewed. The requirements for research and development piloted simulation are addressed as well as the capabilities and technologies that are currently available or are being developed by NASA and the Army at Ames. The application of revolutionary advances (in visual scene, electronic cockpits, motion, and modelling of interactive mission environments and/or vehicle systems) to the NASA/Army facilities are also addressed. Particular attention is devoted to the major advances made in integrating these individual capabilities into fully integrated simulation environment that were or are being applied to new rotorcraft mission requirements. The specific simulators discussed are the Vertical Motion Simulator and the Crew Station Research and Development Facility. Author

N88-16652*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
SYSTEM ANALYSIS IN ROTORCRAFT DESIGN: THE PAST DECADE c05
Thomas L. Galloway *In* NASA, Washington, NASA/Army Rotorcraft Technology. Volume 3: Systems Integration, Research Aircraft, and Industry Feb. 1988 p 1154-1166 (For primary document see N88-16650 09-01)
Avail: NTIS HC A17/MF A01 CSCL 01C

Rapid advances in the technology of electronic digital computers and the need for an integrated synthesis approach in developing future rotorcraft programs has led to increased emphasis on system analysis techniques in rotorcraft design. The task in systems analysis is to deal with complex, interdependent, and conflicting requirements in a structured manner so rational and objective decisions can be made. Whether the results are wisdom or rubbish depends upon the validity and sometimes more importantly, the consistency of the inputs, the correctness of the analysis, and a sensible choice of measures of effectiveness to draw conclusions. In rotorcraft design this means combining design requirements, technology assessment, sensitivity analysis and reviews techniques currently in use by NASA and Army organizations in developing research programs and vehicle specifications for rotorcraft. These procedures span simple graphical approaches to comprehensive analysis on large mainframe computers. Examples of recent applications to military and civil missions are highlighted. Author

N88-16653*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
AN INTEGRATED APPROACH TO ROTORCRAFT HUMAN FACTORS RESEARCH c54
Sandra G. Hart, E. James Hartzell, James W. Voorhees, Nancy M. Bucher, and R. Jay Shively (Army Aviation Systems Command, Moffett Field, Calif.) *In* NASA, Washington, NASA/Army Rotorcraft Technology. Volume 3: Systems Integration, Research Aircraft, and Industry Feb. 1988 p 1167-1188 (For primary document see N88-16650 09-01)
Avail: NTIS HC A17/MF A01 CSCL 05H

As the potential of civil and military helicopters has increased, more complex and demanding missions in increasingly hostile environments have been required. Users, designers, and manufacturers have an urgent need for information about human behavior and function to create systems that take advantage of human capabilities, without overloading them. Because there is a large gap between what is known about human behavior and the information needed to predict pilot workload and performance in the complex missions projected for pilots of advanced helicopters, Army and NASA scientists are actively engaged in Human Factors Research at Ames. The research ranges from laboratory experiments to computational modeling, simulation evaluation, and inflight testing. Information obtained in highly controlled but simpler environments generates predictions which can be tested in more realistic situations. These results are used, in turn, to refine theoretical models, provide the focus for subsequent research, and ensure operational relevance, while maintaining predictive advantages. The advantages and disadvantages of each type of research are described along with examples of experimental results. Author

N88-16654*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
AVIONICS SYSTEMS INTEGRATION TECHNOLOGY c06
George Stech and James R. Williams *In* NASA, Washington, NASA/Army Rotorcraft Technology. Volume 3: Systems Integration, Research Aircraft, and Industry Feb. 1988 p 1189-1210 (For primary document see N88-16650 09-01)
Avail: NTIS HC A17/MF A01 CSCL 01D

A very dramatic and continuing explosion in digital electronics technology has been taking place in the last decade. The prudent and timely application of this technology will provide Army aviation the capability to prevail against a numerically superior enemy threat. The Army and NASA have exploited this technology explosion in the development and application of avionics systems integration technology for new and future aviation systems. A few selected Army avionics integration technology base efforts are discussed. Also discussed is the Avionics Integration Research Laboratory (AIRLAB) that NASA has established at Langley for research into the integration and validation of avionics systems, and evaluation of advanced technology in a total systems context. Author

N88-16655*# Army Research and Technology Labs., Fort Eustis, Va. Aviation Applied Technology Directorate.
INTEGRATED DIAGNOSTICS c06
Roger J. Hunthausen *In* NASA, Washington, NASA/Army Rotorcraft Technology. Volume 3: Systems Integration, Research Aircraft, and Industry Feb. 1988 p 1211-1230 (For primary document see N88-16650 09-01)
Avail: NTIS HC A17/MF A01 CSCL 01D

Recently completed projects in which advanced diagnostic concepts were explored and/or demonstrated are summarized. The projects begin with the design of integrated diagnostics for the Army's new gas turbine engines, and advance to the application of integrated diagnostics to other aircraft subsystems. Finally, a recent project is discussed which ties together subsystem fault monitoring and diagnostics with a more complete picture of flight domain knowledge. Author

N88-16656*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
ROTORCRAFT FLIGHT RESEARCH WITH EMPHASIS ON ROTOR SYSTEMS c05
William J. Snyder *In* NASA, Washington, NASA/Army Rotorcraft Technology. Volume 3: Systems Integration, Research Aircraft, and Industry Feb. 1988 p 1235-1273 (For primary document see N88-16650 09-01)
Avail: NTIS HC A17/MF A01 CSCL 01C

Over fifty years of contributions by NASA and the Army through rotor systems flight research were examined with an emphasis on the last 25 years. During this time, the helicopter has gone from an abnormality that did a few useful things to a vehicle that is a necessity to life in this country and a major part of all military forces in the world. Major data acquisition programs like the H-34 and White Cobra have been undertaken that have increased the understanding of the aerodynamic behavior of the rotor system. Specialized programs like the Ogee tip on the UH-1 and the flight tests of the hingeless rotor helicopters, the XH-13 and XH-51N, contributed greatly to the understanding of these technologies. The extensive airfoil test program also undertaken on the White Cobra provided valuable data on advanced airfoil configurations. Author

N88-16657*# Textron Bell Helicopter, Fort Worth, Tex.
AN OVERVIEW OF KEY TECHNOLOGY THRUSTS AT BELL HELICOPTER TEXTRON c05
James H. Harse, Jing G. Yen, and Rodney S. Taylor *In* NASA, Washington, NASA/Army Rotorcraft Technology. Volume 3: Systems Integration, Research Aircraft, and Industry Feb. 1988 p 1279-1340 (For primary document see N88-16650 09-01)
Avail: NTIS HC A17/MF A01 CSCL 01C

Insight is provided into several key technologies at Bell. Specific topics include the results of ongoing research and development in advanced rotors, methodology development, and new configurations. The discussion on advanced rotors highlight developments on the composite, bearingless rotor, including the development and testing of full scale flight hardware as well as some of the design support analyses and verification testing. The discussion on methodology development concentrates on analytical development in aeromechanics, including correlation studies and design application. New configurations, presents the results of some advanced configuration studies including hardware development. Author

N88-16658*# Boeing Vertol Co., Philadelphia, Pa.
ROTORCRAFT TECHNOLOGY AT BOEING VERTOL: RECENT ADVANCES c05
John Shaw, Leo Dadone, and Robert Wiesner *In* NASA, Washington, NASA/Army Rotorcraft Technology. Volume 3: Systems Integration, Research Aircraft, and Industry Feb. 1988 p 1341-1394 (For primary document see N88-16650 09-01)
Avail: NTIS HC A17/MF A01 CSCL 01C

An overview is presented of key accomplishments in the rotorcraft development at Boeing Vertol. Projects of particular significance: high speed rotor development and the Model 360 Advanced Technology Helicopter. Areas addressed in the overview are: advanced rotors with reduced noise and vibration, 3-D aerodynamic modeling, flight control and avionics, active control, automated diagnostics and prognostics, composite structures, and drive systems. Author

N88-16659*# Sikorsky Aircraft, Stratford, Conn.
RECENT SIKORSKY R AND D PROGRESS c05
In NASA, Washington, NASA/Army Rotorcraft Technology. Volume 3: Systems Integration, Research Aircraft, and Industry Feb. 1988 p 1395-1449 (For primary document see N88-16650 09-01)
Avail: NTIS HC A17/MF A01 CSCL 01C

The recent activities and progress in four specific areas of Sikorsky's research and development program are summarized. Since the beginning of the S-76 design in 1974, Sikorsky has been aggressively developing the technology for using composite materials in helicopter design. Four specific topics are covered: advanced cockpit/controller efforts, fly-by-wire controls on RSRA/X-Wing, vibration control via higher harmonic control, and main rotor aerodynamic improvements. Author

N88-16660*# McDonnell-Douglas Helicopter Co., Mesa, Ariz.
MCDONNELL DOUGLAS HELICOPTER COMPANY INDEPENDENT RESEARCH AND DEVELOPMENT: PREPARING FOR THE FUTURE c05
Allen C. Haggerty *In* NASA, Washington, NASA/Army Rotorcraft Technology. Volume 3: Systems Integration, Research Aircraft, and Industry Feb. 1988 p 1450-1481 (For primary document see N88-16650 09-01)
Avail: NTIS HC A17/MF A01 CSCL 01C

During the 1970's and 80's, research has produced the technology that is seen in aircraft such as the LHX and future models. The technology is discussed that is reaching maturity and moving into the application stage of future programs. Technology is discussed in six major areas: advanced concepts, analysis techniques, structures, systems, simulation, and research and development facilities. The partnership of McDonnell Douglas Helicopter Co. and the government in developing these technologies is illustrated in several programs. Author

N88-16661* National Aeronautics and Space Administration, Washington, D.C.
AERONAUTICAL ENGINEERING: A CONTINUING BIBLIOGRAPHY WITH INDEXES (SUPPLEMENT 223)
Feb. 1988 123 p
(NASA-SP-7037(223); NAS 1.21:7037(223)) Avail: NTIS HC A06; NTIS standing order as PB88-914100, $8.50 domestic, $17.00 foreign CSCL 01A

This bibliography lists 423 reports, articles, and other documents introduced into the NASA scientific and technical information system in January, 1988. Author

02 AERODYNAMICS

Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery.

For related information see also *34 Fluid Mechanics and Heat Transfer.*

N88-16662*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
A SIMPLIFIED APPROACH TO AXISYMMETRIC DUAL-REFLECTOR ANTENNA DESIGN
Raymond L. Barger Mar. 1988 14 p
(NASA-TP-2797; L-16392; NAS 1.60:2797) Avail: NTIS HC A03/MF A01 CSCL 20N

A procedure is described for designing dual reflector antennas. The analysis is developed by taking each reflector to be the envelope of its tangent planes. Rather than specifying the phase distribution in the emitted beam, the slopes of the emitted rays

were specified. Thus, both the output wave shape and angular distribution of intensity can be specified. Computed examples include variations from both Cassegrain and Gregorian systems, permitting deviation from uniform source distributions and from parallel beam property of conventional systems. Author

N88-16663*# Texas A&M Univ., College Station. Dept. of Aerospace Engineering.
AN INITIAL INVESTIGATION INTO METHODS OF COMPUTING TRANSONIC AERODYNAMICS SENSITIVITY COEFFICIENTS Semiannual Progress Report, 1 Jul. - 31 Dec. 1987
Leland A. Carlson Feb. 1988 42 p
(Grant NAG1-793)
(NASA-CR-182444; NAS 1.26:182444; TAMRF-5802-88-01)
Avail: NTIS HC A03/MF A01 CSCL 01A

Based upon the program outlined in the modified proposal, the initial effort has concentrated on developing the quasi-analytical approach for determining aerodynamic influence coefficients. In addition, in order to keep these initial efforts computationally efficient and straightforward, it was decided to first consider only two-dimensional flow and to model the problem using the transonic small perturbation equation with surface boundary conditions applied along the slit. The small perturbation equation was selected instead of the full potential equation because it permits the capturing of important nonlinear physical phenomena while being by comparison easy to handle from a coding standpoint. Consequently, the initial objectives were: (1) investigate the feasibility of using the quasi-analytical approach for determining aerodynamic sensitivity coefficients in the transonic regime; (2) determine the accuracy of the quasi-analytical approach by comparing results to those computed using finite difference techniques; and (3) investigate efficient methods for solving the large set of equations associated with the quasi-analytical approach. Author

N88-16664# Brown Univ., Providence, R. I. Div. of Applied Mathematics.
NEW TECHNIQUES IN COMPUTATIONAL AERODYNAMICS Final Report, 1 Jun. 1983 - 28 Feb. 1987
Lawrence Sirovich 6 Aug. 1987 95 p
(Grant AF-AFOSR-0336-83)
(AD-A186719; AFOSR-87-1419TR) Avail: NTIS HC A05/MF A01 CSCL 20D

A wide range of problems in gas dynamics have been considered. Advances in subsonic, transonic, and supersonic gas dynamics have been made. The emphasis has been made on computational procedures both numerical and algebraic. This work has a strong basis in analytical methods, and goal has been to produce computational efficient codes which made optimal use of analytically known results. GRA

N88-16665# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (West Germany). Inst. fuer Experimentelle Stroemungsmechanik.
WIND TUNNEL INVESTIGATIONS OF PERIODIC VORTEX SEPARATION ON ROUGH-SURFACE CIRCULAR CYLINDERS USING ACOUSTIC MEASURING METHODS
Friedrich R. Grosche, Horst Stiewitt, and Hans Hoefer Jun. 1987 100 p In GERMAN; ENGLISH summary
(DFVLR-FB-87-24; ISSN-0171-1342; ETN-88-91011) Avail: NTIS HC A05/MF A01; DFVLR, Cologne, Federal Republic of Germany DM 29

The sound generation due to periodic vortex separation from a circular cylinder in a cross flow (Aeolian tones) was measured in a large low speed wind tunnel at Reynolds numbers between 10,000 and 40,000. At low Reynolds numbers (less than 40,000) results agree well with predictions based on flow measurements with smooth cylinders. Deviations occurring at higher Reynolds numbers are explained by effects of the surface roughness of the model, which reduces the critical Reynolds number to 20,000. A helical trip wire wrapped around the cylinder decreases the sound level by up to 20 dB. Equations to predict the sound intensity at arbitrary positions in the acoustic far field from the experimental results were derived. ESA

N88-16666# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (West Germany). Inst. fuer Experimentelle Stroemungsmechanik.
EXPERIMENTAL INVESTIGATION OF SHOCK-INDUCED DISTURBANCES ON TRANSONIC AIRFOILS Ph.D. Thesis - Goettingen Univ., Fed. Republic of Germany
Dieter Basler Jul. 1987 128 p In GERMAN; ENGLISH summary Report will also be announced as translation (ESA-TT-1097)
(DFVLR-FB-87-28; ISSN-0171-1342; ETN-88-91450) Avail: NTIS HC A07/MF A01; DFVLR, Cologne, Fed. Republic of Germany DM 38

The mechanism of buffeting was investigated in a wind tunnel on a transonic airfoil. A holographic high speed real time interferometer was developed to observe and analyze the entire flow field surrounding the airfoil. The information from interferograms was compared with results from hot film and pressure measurements. The results show that the shock oscillation can be described by an interaction of the shock with the boundary layer and the flow conditions at the trailing edge of the airfoil. The observed buffet frequencies are higher for an initially laminar boundary layer than for a turbulent boundary layer. Buffer frequency decreases with increasing Reynolds number in the case of a turbulent boundary layer. ESA

N88-16667# Royal Aircraft Establishment, Farnborough (England).
THE AERODYNAMIC PERFORMANCE OF PROPELLERS SUITABLE FOR UNMANNED AIRCRAFT (UMAS)
W. J. G. Treble Jan. 1987 25 p
(RAE-TM-AERO-2094; BR102328; ETN-88-91530) Copyright
Avail: NTIS HC A03/MF A01

The aerodynamic performance of 13 cheap fixed-pitch 0.512 m diameter pusher-propellers suitable for powering unmanned aircraft for low speed missions (i.e., less than 50 m/sec) was investigated. Ten of them were twin-bladed and three of them had four blades. Thrust and torque at rotational speeds between 3000 and 9000 rpm in the 1.5 m acoustic tunnel at airspeeds from 10 to 50 m/sec were measured. As expected, propellers with coarser blade settings require more power and produce more thrust than those with finer pitch, and peak efficiency is delayed to higher values of the advance ratio (J). The peak efficiency is between 70 and 80 percent measured efficiency over the normal operating range (J=0.4 to 0.6) is 80 to 85 percent of the ideal efficiency, for a propeller of a different design performance is degraded by a further 10 percent. ESA

N88-16668*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
COMPUTATIONAL UNSTEADY AERODYNAMICS FOR AEROELASTIC ANALYSIS
Woodrow Whitlow, Jr. Dec. 1987 29 p
(NASA-TM-100523; NAS 1.15:100523) Avail: NTIS HC A03/MF A01 CSCL 01A

This report summarizes the status of computational unsteady aerodynamics methods for aeroelastic analysis and makes recommendations for future research activities. The flight conditions for which various types of flows exist are described and the aeroelastic phenomena that can occur in those flight regimes are discussed. Some important aeroelastic problems of current interest are described, and the aerodynamic methods needed to analyze them are presented. The capabilities and limitations of existing unsteady aerodynamics methods are discussed. Computer resources required to perform aeroelastic analysis of various flight vehicle configurations are presented. Recommendations for future research are made, and schedules for completion of proposed research tasks are presented. Author

N88-16669# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).

METHOD OF ITERATIVE COUPLING BETWEEN PERIODIC AERODYNAMIC AND DYNAMIC FIELDS

C. T. Tran Aug. 1986 27 p In FRENCH Sponsored by Direction des Recherches, Etudes et Techniques, Paris, France
(PB87-169934; ONERA-RT-19/3239-RY) Avail: NTIS HC E04/MF E04 CSCL 01A

An iterative algorithm between periodic aerodynamic fields has been established. The algorithm is based on artificial introduction of a simplified aerodynamic model. Averaging of certain optimization procedures makes it possible to arrive at a faster convergence.
Author

N88-16670# Association Aeronautique et Astronautique de France, Paris.

EFFECT OF A MODEL SUPPORT STRUT ON MEASUREMENT OF AERODYNAMIC LONGITUDINAL AND LATERAL COEFFICIENTS

M. Quemard, M. VandeKreeke, and M. Verriere Nov. 1986 32 p In FRENCH Sponsored by Direction des Recherches, Etudes et Techniques, Paris, France Prepared in cooperation with ONERA, Paris, France and Centre d'Essais Aeronautique de Toulouse, France
(PB87-170288; NOTE-TECHNIQUE-86-09; ISBN-2-7170-0857-8)
Avail: NTIS HC E04/MF E04 CSCL 01A

Lateral stability tests were run in wind tunnels on civilian airplane models mounted on a single strut. The model was balanced atop a vertical strut tied in with the devices regulating the angles of attack and sideslip. Significant discrepancies in lateral stability were noted during testing of the ATR 42 models in the two wind tunnels. It was shown that the very visible interaction of the ATR 42 strut with the landing gear fairing was responsible and that the effect was proportional to the relative thickness of the strut. Ground effects are studied by lowering the model toward the floor with a telescoping mask. Measurements also furnished the figures needed to correct the absolute values of the lift and pitching moment coefficients.
Author

N88-16671# Association Aeronautique et Astronautique de France, Paris.

TESTING OF A SCHEMATIC TRANSPORT PLANE MODEL IN SEVERAL EUROPEAN WINDTUNNELS

V. Schmitt Nov. 1986 30 p In FRENCH Presented at the 23rd Colloque d'Aerodynamique Appliquee, Modane, France, 12-14 Nov. 1986 Sponsored by Direction des Recherches, Etudes et Techniques, Paris, France Prepared in cooperation with Office National d'Etudes et de Recherches Aerospatiales, Paris, France
(PB87-170270; NOTE-TECHNIQUE-86-08; ISBN-2-7170-0856-X)
Avail: NTIS HC E04/MF E04 CSCL 01A

An international program was carried out to improve design methods for three dimensional configurations and to increase confidence in experimental data. The selected configuration was the DFVLR-F4 wing body incorporating a high aspect ratio supercritical wing and an Airbus type fuselage. For the experimental part of the exercise, a single model was tested in the major European wind tunnels. The transonic test consisted mainly of global force and moment measurements and measurement of pressure distributions on the wing and fuselage. The results were analyzed and compared.
Author

N88-16672# Association Aeronautique et Astronautique de France, Paris.

DESCRIPTION OF TESTS RUN IN THE T2 CRYOGENIC WIND TUNNEL

A. Seraudie, A. Blanchard, and J. B. Dor Nov. 1986 51 p Sponsored by Direction des Recherches, Etudes et Techniques, Paris, France Prepared in cooperation with ONERA, Paris, France and Centre d'Etudes et de Recherches, Toulouse, France
(PB87-170296; NOTE-TECHNIQUE-86-07; ISBN-2-7170-0855-1)
Avail: NTIS HC E04/MF E04 CSCL 01A

Research done on the testing techniques and measurement methods to be used in the T2 pressurized cryogenic wind tunnel is described. It was found that the model temperature must be established before measuring the gust. Several rounds of cryogenic tests provided valuable experience in conducting cold flow measurements. Cross checking was done to validate the tests. However, some experimental snags related to high unit Reynolds numbers were encountered during natural transition tests. It was found necessary to take the level of flow turbulence into account and to improve the condition of the model surfaces to maintain a laminar state in the boundary layers of most of the airfoils.
Author

N88-16673# Ecole Polytechnique, Palaiseau (France). Centre de Mathematiques Appliquees.

NUMERICAL RESOLUTION OF THE EQUATIONS OF THREE-DIMENSIONAL STABLE COMPRESSIBLE TRANSONIC FLOWS Final Report

J. C. Nedelec Jul. 1986 49 p In FRENCH Sponsored by Direction des Recherches, Etudes et Techniques, Paris, France
(PB87-168415) Avail: NTIS HC E04/MF E04 CSCL 01A

Three dimensional, compressible, transonic and stable flows of the air around an aircraft wing are discussed. A fixed point technique is used to deal with the nonlinearity of the problem and the concept of delayed density to take the hyperbolic nature of the equations in the supersonic range into account. A formulation in either scaler potential or in vectorial potential is used to solve the elliptical problem associated with each nonlinear passage. The two types of methods are compared.
Author

N88-16674*# Florida Univ., Gainesville. Dept. of Engineering Sciences.

A JET IN A CROSSFLOW Final Report, 1 Jan. 1978 - 31 Jul. 1987

Richard L. Fearn 3 Mar. 1988 8 p
(Grant NsG-2288)
(NASA-CR-182469; NAS 1.26:182469) Avail: NTIS HC A02/MF A01 CSCL 01A

In the transition from hover to wingborn flight, V/STOL aircraft rely on the direct thrust of lift jets to supplement wing generated lift. The lifting jets interact with the flow over the aerodynamic surface to produce a complex flow around the aircraft. The simplest configuration which retains the essential characteristics of the jet/aerodynamic-surface interaction problem is a subsonic round jet exhausting perpendicularly through a large flat plate into a uniform crossflow. This configuration was studied extensively, both by experiment and by analysis. As a result, a fairly complete experiment data base exists for comparison with the numerical calculations. Research publications and presentations in this area are included. Each citation is followed by an abstract of the work.
B.G.

N88-16675*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

MACH NUMBER EFFECTS ON TRANSONIC AEROELASTIC FORCES AND FLUTTER CHARACTERISTICS

Ross W. Mohr, John T. Batina, and Henry T. Y. Yang (Purdue Univ., West Lafayette, Ind.) Feb. 1988 13 p Proposed for presentation at the AIAA/ASME/ASCE/AHS/ASC 29th Structures, Structural Dynamics and Materials Conference, Williamsburg, Va.
(NASA-TM-100547; NAS 1.15:100547; AIAA-88-2304) Avail: NTIS HC A03/MF A01 CSCL 01A

Transonic aeroelastic stability analysis and flutter calculations are presented for a generic transport-type wing based on the use of the CAP-TSD (Computational Aeroelasticity Program - Transonic Small Disturbance) finite-difference code. The CAP-TSD code was recently developed for transonic unsteady aerodynamic and aeroelastic analysis of complete aircraft configurations. A binary aeroelastic system consisting of simple bending and torsion modes was used to study aeroelastic behavior at transonic speeds. Generalized aerodynamic forces are presented for a wide range of Mach number and reduced frequency. Aeroelastic characteristics are presented for variations in freestream Mach number, mass ratio, and bending-torsion frequency ratio. Flutter boundaries are presented which have two transonic dips in flutter speed. The

first dip is the usual transonic dip involving a bending-dominated flutter mode. The second dip is characterized by a single degree-of-freedom torsion oscillation. These aeroelastic results are physically interpreted and shown to be related to the steady state shock location and changes in generalized aerodynamic forces due to freestream Mach number. Author

N88-16676# Cranfield Inst. of Tech., Bedford (England). Coll. of Aeronautics.
FULL SCALE AND WIND TUNNEL SURFACE PRESSURE MEASUREMENTS ON THE T.R.R.L. SPRAY DISPERSION PROGRAMME VEHICLES
N. A. Cowperthwaite and K. P. Garry Dec. 1987 91 p
(Rept-8623; ISBN-0-947767-80-0) Avail: NTIS HC A05/MF A01

A co-ordinated program of wind tunnel and full scale experiments was performed to gain insight into the flowfield, related to water spray dispersion, around articulated tractor-trailers. Specifically, the surface static pressure measurements made in support of that program are covered. Measurements were made on the surface of a standard 40 ft box container, coupled with two alternative tractor units, at full scale on a test track and at approximately 1/5 full scale Reynolds number, using wind tunnel models. The wind tunnel program includes pressure measurements on models fitted with a cab roof deflector and trailer side skirts. An assessment is made of the flowfield changes that results from such modifications. Correlation between wind tunnel and full scale pressure distribution is seen, from available data, to be dependent on the degree of matching between cab and container flowfields. The full scale pressure measuring and data recording system developed specifically for this program is seen to be satisfactory given suitable test weather conditions. Further research is required to extend the available full scale data and examine the correlation with various wind tunnel simulation techniques. Author

N88-16677# Aeronautical Research Labs., Melbourne (Australia).
A NOTE ON THE AERODYNAMIC DESIGN OF THIN PARALLEL-SIDED AEROFOIL SECTIONS
N. Pollock Sep. 1987 28 p
(ARL-AERO-TM-388; AR-004-551) Avail: NTIS HC A03/MF A01

There are many situations where parallel-sided airfoil sections with leading and trailing edge fairings of limited chordwise extent have advantages over conventional sections. The design of these unconventional sections was investigated using two potential flow plus boundary layer computer programs. Guidelines for the selection of the leading and trailing edge fairing shapes are presented. Author

N88-16678*# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
AN EXPERIMENTAL INVESTIGATION OF THE CHOPPING OF HELICOPTER MAIN ROTOR TIP VORTICES BY THE TAIL ROTOR. PART 2: HIGH SPEED PHOTOGRAPHIC STUDY Final Report, Sep. 1985 - Aug. 1987
Charles M. Cary 8 Sep. 1987 62 p
(Contract NAS2-12256)
(NASA-CR-177457; NAS 1.26:177457; TM-977) Avail: NTIS HC A04/MF A01 CSCL 01A

The interaction of a free vortex and a rotor was recorded photographically using oil smoke and stroboscopic illumination. The incident vortex is normal to the plane of the rotor and crosses the rotor plane. This idealized aerodynamic experiment most nearly corresponds to helicopter flight conditions in which a tip vortex from the main rotor is incident upon the tail rotor while hovering. The high speed photographs reveal important features not observed using conventional photography where the image is the time average of varying instantaneous images. Most prominent is the strong interaction between the rotor tip vortex system and the incident vortex, resulting in the roll-up of the incident vortex around the (stronger) tip vortices and the resulting rapid destabilization of the deformed incident vortex. The viscous interaction is clearly shown also. Other forms of instabilities or wave-like behavior may be apparent from further analysis of the photographs. Author

N88-16679*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
CFD VALIDATION EXPERIMENTS FOR INTERNAL FLOWS
Louis A. Povinelli 1988 22 p Proposed for presentation at the Symposium on Validation of Computational Fluid Dynamics, Lisbon, Portugal, 2-5 May 1988; sponsored by AGARD
(NASA-TM-100797; E-3973; NAS 1.15:100797) Avail: NTIS HC A03/MF A01 CSCL 01A

Computational Fluid Dynamics (CFD) validation experiments at NASA Lewis Research Center are described. The material presented summarizes the research in three areas: Inlets, Ducts and Nozzles; Turbomachinery; and Chemically Reacting Flows. The specific validation activities are concerned with shock-boundary layer interactions, vortex generator effects, large low speed centrifugal compressor measurements, transonic fan shock structure, rotor/stator kinetic energy distributions, stator wake shedding characteristics, boundary layer transition, multiphase flow and reacting shear layers. These experiments are intended to provide CFD validation data for the internal flow fields within aerospace propulsion system components. Author

N88-16680*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
LOADS AND AEROELASTICITY DIVISION RESEARCH AND TECHNOLOGY ACCOMPLISHMENTS FOR FY 1987 AND PLANS FOR FY 1988
S. C. Dixon and James E. Gardner Jan. 1988 143 p
(NASA-TM-100534; NAS 1.15:100534) Avail: NTIS HC A07/MF A01 CSCL 01A

The purpose of this paper is to present the Loads and Aeroelasticity Division's research accomplishments for FY87 and research plans for FY88. The work under each Branch (technical area) is described in terms of highlights of accomplishments during the past year and highlights of plans for the current year as they relate to five year plans for each technical area. This information will be useful in program coordination with other government organizations and industry in areas of mutual interest. Author

N88-16681*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ON THE CORRELATION OF PLUME CENTERLINE VELOCITY DECAY OF TURBULENT ACOUSTICALLY EXCITED JETS
Uwe H. vonGlahn 1987 35 p Presented at the 11th Aeroacoustics conference, Sunnyvale, Calif., 19-21 Oct. 1987; sponsored by AIAA Previously announced in IAA as A88-18654
(NASA-TM-100193; E-3780; NAS 1.26:100193; AIAA-87-2692)
Avail: NTIS HC A03/MF A01 CSCL 01A

Acoustic excitation was shown to alter the velocity decay and spreading characteristics of jet plumes by modifying the large-scale structures in the plume shear layer. The present work consists of reviewing and analyzing available published and unpublished experimental data in order to determine the importance and magnitude of the several variables that contribute to plume modification by acoustic excitation. Included in the study were consideration of the effects of internal and external acoustic excitation, excitation Strouhal number, acoustic excitation level, nozzle size, and flow conditions. The last include jet Mach number and jet temperature. The effects of these factors on the plume centerline velocity decay are then summarized in an overall empirical correlation. Author

N88-16630*# Army Aviation Systems Command, Moffett Field, Calif.
COMPREHENSIVE ROTORCRAFT ANALYSIS METHODS
Wendell B. Stephens and Edward E. Austin (Army Research and Technology Labs., Fort Eustis, Va.) *In* NASA, Washington, NASA/Army Rotorcraft Technology. Volume 1: Aerodynamics, and Dynamics and Aeroelasticity Feb. 1988 p 312-352 (For primary document see N88-16625 09-01)
Avail: NTIS HC A23/MF A01 CSCL 01A

03 AIR TRANSPORTATION AND SAFETY

Includes passenger and cargo air transport operations; and aircraft accidents.

For related information see also *16 Space Transportation* and *85 Urban Technology and Transportation.*

N88-16682# Federal Aviation Administration, Oklahoma City, Okla. Civil Aeromedical Inst.
SUDDEN IN-FLIGHT INCAPACITATION IN GENERAL AVIATION Final Report
Charles F. Booze, Jr. Aug. 1987 12 p
(AD-A187044; DOT/FAA/AM-87/7) Avail: NTIS HC A03/MF A01 CSCL 06E

Incapacitation in the general aviation flight environment is a matter of utmost concern to the Federal Aviation Administration since the likelihood of accident is greater due to lack of redundant pilot skills in most instances. The purpose of this study was to appraise the adequacy of medical standards in minimizing the risk of sudden incapacitation. This study considers NTSB data and postcrash medical data received by the Medical Statistical Section of the Civil Aeromedical Institute (CAMI), Oklahoma City, Oklahoma, during the time period from 1975 to the present and other related literature to estimate the probability of incapacitation in general aviation. The occurrence of incapacitation for obvious medical reasons is less than would be expected based on general population morbidity/mortality data; however, the need for continued vigilance in certification and education regarding flying with known or suspected medical problems is emphasized. GRA

N88-16683# National Aerospace Lab., Amsterdam (Netherlands). Informatics Div.
VERIFICATION OF OBSTACLE ACCOUNTABILITY AREAS USING A SIMPLE MATHEMATICAL MODEL. PART 1: DESCRIPTION OF GENERAL MODEL AND APPLICATION FOR A SPECIFIC CASE
G. Moek 2 May 1985 54 p
(Contract RB-RLD-1985-2.1/VZ)
(NLR-TR-85069-U; ETN-88-90184) Avail: NTIS HC A04/MF A01

A probabilistic model for the lateral displacement of an aircraft after the occurrence of an engine failure during take-off is described. A lateral boundary is calculated, for any point of time after the engine failure, such that the probability of being within the (two sided) lateral boundary meets a specified value. Probability distributions for the three model parameters are considered. The model is elaborated for a specific set of probability distributions. The resulting lateral boundaries are compared with the present ICAO annex 6 obstacle accountability area. The duration of the (deterministic) first phase, when in the range of 10 to 15 sec does not significantly influence the magnitude of the computed boundary. The magnitude of the angle between flight direction and runway center line and the aircraft speed, however, have a considerable effect on the magnitude of the boundary. ESA

N88-16684 Civil Aviation Authority, London (England). Safety Data and Analysis Unit.
ANALYSIS OF BIRD STRIKES TO UK REGISTERED AIRCRAFT 1985 (CIVIL AIRCRAFT OVER 5700 kg MAXIMUM WEIGHT
J. Thorpe Sep. 1987 20 p
(CAA-Paper-87012; ISBN-0-86039-323-2; ISSN-0269-4956; ETN-88-91517) Copyright Avail: Issuing Activity

Bird strikes reported throughout the world in 1985 by UK airlines were analyzed. The analysis includes strike rates for aircraft types and operators based on aircraft movements. It also covers aerodromes, bird species, and effect of strike. Strike rate in 1985 is slightly less than in 1984. Gulls (Larus spp.) were involved in 39 percent of incidents where the bird species were identified. The major effect was damage to 20 engines, and there were 5 cases in which more than 1 engine on an aircraft suffered ingestion. ESA

N88-16685# National Transportation Safety Board, Washington, D. C.
AIRCRAFT ACCIDENT/INCIDENT SUMMARY REPORTS, DES MOINES, IOWA, NOVEMBER 25, 1985; CHICAGO, ILLINOIS, AUGUST 10, 1986
30 Sep. 1987 24 p
(PB88-910411; NTSB/AAR-87/03/SUM) Avail: NTIS HC A03/MF A01; also available on subscription, North American Continent HC $60.00/year, all others write for quote CSCL 01C

The publication is a compilation of the reports of two separate aircraft accidents investigated by the National Transportation Safety Board. The accident locations and their dates are as follows: Des Moines, Iowa, November 25, 1985, and Chicago, Illinois, August 10, 1986. GRA

N88-16635*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
HELICOPTER CRASHWORTHINESS RESEARCH PROGRAM
Gary L. Farley, Richard L. Boitnott (Army Research and Technology Labs., Fort Eustis, Va.), and Huey D. Carden *In* NASA, Washington, NASA/Army Rotorcraft Technology. Volume 2: Materials and Structures, Propulsion and Drive Systems, Flight Dynamics and Control, and Acoustics Feb. 1988 p 606-655 (For primary document see N88-16632 09-01)
Avail: NTIS HC A25/MF A01 CSCL 01C

N88-16641*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
NASA'S ROTORCRAFT ICING RESEARCH PROGRAM
Robert J. Shaw, John J. Reinmann, and Thomas L. Miller (Sverdrup Technology, Inc., Cleveland, Ohio.) *In* NASA, Washington, NASA/Army Rotorcraft Technology. Volume 2: Materials and Structures, Propulsion and Drive Systems, Flight Dynamics and Control, and Acoustics Feb. 1988 p 802-832 (For primary document see N88-16632 09-01)
Avail: NTIS HC A25/MF A01 CSCL 01C

04 AIRCRAFT COMMUNICATIONS AND NAVIGATION

Includes digital and voice communication with aircraft; air navigation systems (satellite and ground based); and air traffic control.

For related information see also *17 Space Communications, Spacecraft Communications, Command and Tracking* and *Communications and Radar.*

N88-16686# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Cologne (West Germany). Hauptabteilung Verkehrsforschung.
ADDITIONAL INVESTIGATIONS IN LANDING PROCESS OF AIRCRAFT: TEST DISTRIBUTIONS
Hanns-Juergen Peters Jun. 1987 76 p In GERMAN; ENGLISH summary Report will also be announced as translation (ESA-TT-1099)
(DFVLR-Mitt-87-13; ISSN-0176-7739; ETN-88-91452) Avail: NTIS HC A05/MF A01; DFVLR, Colog ne, Fed. Republic of Germany DM 25.50

The landing times for the 10 German civil airports, without waiting times due to aircraft allocations to holding areas, were investigated using a simulation model for the landing process. Test distributions were developed. Results are synthetic landing time distributions with waiting times, the adaptation of which to the empirical landing time distribution was evaluated using the Chi-square test. Further improvements of the adaptation of the simulated distribution to the empirical one can be obtained by structural changes of the test distribution, e.g., by limitation of the maximum landing time. ESA

N88-16687*# Ohio State Univ., Columbus. Dept. of Electrical Engineering.
A STUDY OF THE TCAS 2 COLLISION AVOIDANCE SYSTEM MOUNTED ON A BOEING 737 AIRCRAFT
B. Grandchamp, W. D. Burnside, and R. G. Rojas Dec. 1987 175 p
(Grant NsG-1498)
(NASA-CR-182457; NAS 1.26:182457; TR-716199-10) Avail: NTIS HC A08/MF A01 CSCL 17G

The purpose of this report is to determine the effects of scattering from major aircraft structures on the TCAS 2 collision avoidance system mounted on a Boeing 737. It is found that the major source of scattering for angles of observation above the horizon is the vertical stabilizer and that its effect may be greatly reduced by mounting the TCAS 2 array close to the nose of the aircraft. In addition, by mounting the array close to the nose, the effects of fuselage blockage on the array patterns at elevation angles below the horizon may be greatly reduced in the forward direction. Author

N88-16688*# Douglas Aircraft Co., Inc., Long Beach, Calif.
CREW PROCEDURES FOR MICROWAVE LANDING SYSTEM OPERATIONS
Leland G. Summers Nov. 1987 49 p
(Contract NAS1-18028)
(NASA-CR-178359; NAS 1.26:178359) Avail: NTIS HC A03/MF A01 CSCL 17G

The objective of this study was to identify crew procedures involved in Microwave Landing System (MLS) operations and to obtain a preliminary assessment of crew workload. The crew procedures were identified for three different complements of airborne equipment coupled to an autopilot. Using these three equipment complements, crew tasks were identified for MLS approaches and precision departures and compared to an ILS approach and a normal departure. Workload comparisons between the approaches and departures were made by using a task-timeline analysis program that obtained workload indexes, i.e., the radio of time required to complete the tasks to the time available. The results showed an increase in workload for the MLS scenario for one of the equipment complements. However, even this workload was within the capacity of two crew members. Author

05 AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes aircraft simulation technology.

For related information see also *18 Spacecraft Design, Testing and Performance* and *39 Structural Mechanics*.For land transportation vehicles see *85 Urban Technology and Transportation*.

N88-16689# Naval Postgraduate School, Monterey, Calif.
A PILOTED SIMULATION INVESTIGATING HANDLING QUALITIES AND PERFORMANCE REQUIREMENTS OF A SINGLE-PILOT HELICOPTER IN AIR COMBAT EMPLOYING A HELMET-DRIVEN TURRETED GUN M.S. Thesis
Jeffrey N. Williams Sep. 1987 113 p
(AD-A186878) Avail: NTIS HC A06/MF A01 CSCL 01B

The development, implementation, and results of a pilot-in-the-loop fixed-base simulation investigating yaw-axis handling qualities and vehicle maneuverability requirements for the task of single-pilot helicopter air combat at terrain-flight altitudes are presented. Experimental variables included yaw-axis natural frequency and damping. Weapon system type was also varied to include a full- and limited-traverse turret driven by a helmet-mounted sight and a fixed-forward gun. Results indicated that a high yaw natural frequency (omega n = 1.5 to 2.0 rad/sec) and high yaw damping (z eta approx. 1.4) were desirable for Level 1 handling qualities. Pilot ratings generally decreased and the effect of the yaw dynamic characteristics became more pronounced and the weapon system became more restrictive. Other analyses discussed are the vehicle maneuver envelope usage, turret envelope usage, tracking performance, and pilot commentary. GRA

N88-16690# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Systems and Logistics.
A COST AND BENEFIT ANALYSIS OF HYDRAULIC FLUID SYSTEMS FOR THE NEXT GENERATION OF TACTICAL AIRCRAFT M.S. Thesis
Michael P. Mahony Sep. 1987 79 p
(AD-A186911; AFIT/GSM/LSY/87S-18) Avail: NTIS HC A05/MF A01 CSCL 11H

This study analyzed the life cycle costs, cost of fires, and benefits of using a new nonflammable hydraulic fluid (CTFE) in future tactical aircraft versus a fire retardant fluid (Mil-H-83282) currently used, assuming a future hydraulic systems pressure of 8000 psi. A McDonnell Douglas Corporation study compared Mil-H-83282 and CTFE at 8000 psi showing weight as the primary difference. Therefore, this weight difference, the fluid price difference, and the fuel consumption of an F-15 were used to determine the life cycle cost difference between the two systems. Since the added weight was slight, only the additional fuel consumption to fly the extra weight was significant. The added life cycle costs for using CTFE was estimated at $11.4 million in FY87 dollars. Since CTFE will prevent hydraulic fires, an estimate of Mil-H-83282 fire costs was attempted. The differences in the benefits were primarily in the survivability and capability of the aircraft. Taking these differences together CTFE is slightly better than Mil-H-83282 in peacetime. This difference becomes more pronounced in wartime. Finally, a sensitivity analysis was conducted, concluding that CTFE was a viable alternative at 8000 psi. GRA

N88-16691# Analytical Methods, Inc., Redmond, Wash.
PREDICTING DYNAMIC SEPARATION CHARACTERISTICS OF GENERAL CONFIGURATIONS Final Report, Apr. 1984 - Jul. 1987
B. Maskew and F. A. Dvorak Jul. 1987 48 p
(Contract F49620-82-C-0033)
(AD-A186689; AMI-8706; AFOSR-87-1418TR) Avail: NTIS HC A03/MF A01 CSCL 01A

A procedure has been developed for treating the dynamic interaction between a separated wake and a surface undergoing an unsteady motion. The basis of the method is an unsteady (time-stepping) panel method coupled with unsteady integral boundary layer codes. Pilot codes have been developed for both two and three dimensional conditions. Results presented here are mainly from the two-dimensional code in which the various routines for controlling the dynamic wake model have been developed. Some viscous/inviscid three-dimensional results are shown. The long term objective is to treat complete aircraft configurations through high angle-of-attack maneuvers. GRA

N88-16692# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Flugfuehrung.
HELICOPTERS AS TEST CARRIERS FOR AVIONICS SYSTEMS (HETAS) Final Report [HETAS: HUBSCHRAUBER ALS ERPROBUNGSTRAEGER FUER AVIONIK-SYSTEME]
K. Bender, E. Danneberg, R. Dierke, G. Haehnlein, G. Mansfeld, and J. Tersteegen 9 Oct. 1985 28 p In GERMAN
(DFVLR-IB-112-85/18; LVL-8302-I-2; ETN-88-91013) Avail: NTIS HC A03/MF A01

The HETAS integrated test bed for avionics systems in human engineering, digital control engineering, and sensors is presented. The flight test system, including helicopter test carrier, systems concept, and integrated flight test system, is described. The ground test system, including helicopter simulation, cockpit, and redundant fly-by-wire system are described. ESA

N88-16693*# Florida Atlantic Univ., Boca Raton. Dept. of Ocean Engineering.
PARAMETRIC AND EXPERIMENTAL ANALYSIS USING A POWER FLOW APPROACH Semiannual Report

J. M. Cuschieri Feb. 1988 38 p
(Grant NAG1-685)
(NASA-CR-182460; NAS 1.26:182460; SAR-3) Avail: NTIS HC A03/MF A01 CSCL 01C

Having defined and developed a structural power flow approach for the analysis of structure-borne transmission of structural vibrations, the technique is used to perform an analysis of the influence of structural parameters on the transmitted energy. As a base for comparison, the parametric analysis is first performed using a Statistical Energy Analysis approach and the results compared with those obtained using the power flow approach. The advantages of using structural power flow are thus demonstrated by comparing the type of results obtained by the two methods. Additionally, to demonstrate the advantages of using the power flow method and to show that the power flow results represent a direct physical parameter that can be measured on a typical structure, an experimental investigation of structural power flow is also presented. Results are presented for an L-shaped beam for which an analytical solution has already been obtained. Furthermore, the various methods available to measure vibrational power flow are compared to investigate the advantages and disadvantages of each method. Author

N88-16694*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
A FLIGHT-TEST METHODOLOGY FOR IDENTIFICATION OF AN AERODYNAMIC MODEL FOR A V/STOL AIRCRAFT
Ralph E. Bach, Jr. and B. David McNally Mar. 1988 12 p
Submitted for publication
(NASA-TM-100067; A-88095; NAS 1.15:100067) Avail: NTIS HC A03/MF A01 CSCL 01C

Described is a flight test methodology for developing a data base to be used to identify an aerodynamic model of a vertical and short takeoff and landing (V/STOL) fighter aircraft. The aircraft serves as a test bed at Ames for ongoing research in advanced V/STOL control and display concepts. The flight envelope to be modeled includes hover, transition to conventional flight, and back to hover, STOL operation, and normal cruise. Although the aerodynamic model is highly nonlinear, it has been formulated to be linear in the parameters to be identified. Motivation for the flight test methodology advocated in this paper is based on the choice of a linear least-squares method for model identification. The paper covers elements of the methodology from maneuver design to the completed data base. Major emphasis is placed on the use of state estimation with tracking data to ensure consistency among maneuver variables prior to their entry into the data base. The design and processing of a typical maneuver is illustrated.
Author

N88-16695# Association Aeronautique et Astronautique de France, Paris.
AIRPLANE LOAD DROP AND MISSILE FIRING: EXPERIMENTAL METHODS FOR PREDICTING TRAJECTORIES
M. Doulbeau Nov. 1986 35 p In FRENCH Presented at the 23rd Colloque d'Aerodynamique Appliquee, Modane, France, 12-14 Nov. 1986 Sponsored by Direction des Recherches, Etudes et Techniques, Paris, France Prepared in cooperation with Avions Marcel Dassault-Breguet Aviation, Saint-Cloud, France
(PB87-170494; NOTE-TECHNIQUE-86-11; ISBN-2-7170-0859-4)
Avail: NTIS HC E04/MF E04 CSCL 01C

The results of wind tunnel studies using Mirage F1 and Mirage 2000 planes to predict load and missile separation and trajectories are discussed. The results are compared with flight tests to estimate the degree of confidence warranted by the different test methods used (free drops, simulated trajectories) and to evaluate the repercussions of wind tunnel studies on flight testing. Analysis of trajectories was carried out using the geometric interface of an interactive, 3D design assisted system. For most loads, the correlation between wind tunnel and flight test results was good enough for some use to be made of experimental results.
Author

N88-16696# Oak Ridge National Lab., Tenn.
ANALYSIS OF TASKS FOR DYNAMIC MAN/MACHINE LOAD BALANCING IN ADVANCED HELICOPTERS
C. C. Jorgensen Oct. 1987 33 p
(Contract DE-AC05-84OR-21400)
(DE88-003735; ORNL/TM-10558; CESAR-87/44) Avail: NTIS HC A03/MF A01

This report considers task allocation requirements imposed by advanced helicopter designs incorporating mixes of human pilots and intelligent machines. Specifically, it develops an analogy between load balancing using distributed non-homogeneous multiprocessors and human team functions. A taxonomy is presented which can be used to identify task combinations likely to cause overload for dynamic scheduling and process allocation mechanisms. Designer criteria are given for function decomposition, separation of control from data, and communication handling for dynamic tasks. Possible effects of n-p complete scheduling problems are noted and a class of combinatorial optimization methods are examined. DOE

N88-16627*# Army Aviation Systems Command, Moffett Field, Calif.
THE DEVELOPMENT OF CFD METHODS FOR ROTOR APPLICATIONS
F. X. Caradonna and W. J. McCroskey *In* NASA, Washington, NASA/Army Rotorcraft Technology. Volume 1: Aerodynamics, and Dynamics and Aeroelasticity Feb. 1988 p 34-65 (For primary document see N88-16625 09-01)
Avail: NTIS HC A23/MF A01 CSCL 01C

N88-16629*# Army Aviation Systems Command, Moffett Field, Calif.
A REVIEW OF RESEARCH IN ROTOR LOADS
William G. Bousman and Wayne R. Mantay (Army Aerostructures Directorate, Hampton, Va.) *In* NASA, Washington, NASA/Army Rotorcraft Technology. Volume 1: Aerodynamics, and Dynamics and Aeroelasticity Feb. 1988 p 180-311 (For primary document see N88-16625 09-01)
Avail: NTIS HC A23/MF A01 CSCL 01C

N88-16636*# Army Research and Technology Labs., Fort Eustis, Va. Aviation Applied Technology Directorate.
ADVANCED COMPOSITE AIRFRAME PROGRAM: TODAY'S TECHNOLOGY
Danny E. Good and L. Thomas Mazza *In* NASA, Washington, NASA/Army Rotorcraft Technology. Volume 2: Materials and Structures, Propulsion and Drive Systems, Flight Dynamics and Control, and Acoustics Feb. 1988 p 656-678 (For primary document see N88-16632 09-01)
Avail: NTIS HC A25/MF A01 CSCL 01C

N88-16652*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
SYSTEM ANALYSIS IN ROTORCRAFT DESIGN: THE PAST DECADE
Thomas L. Galloway *In* NASA, Washington, NASA/Army Rotorcraft Technology. Volume 3: Systems Integration, Research Aircraft, and Industry Feb. 1988 p 1154-1166 (For primary document see N88-16650 09-01)
Avail: NTIS HC A17/MF A01 CSCL 01C

N88-16656*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
ROTORCRAFT FLIGHT RESEARCH WITH EMPHASIS ON ROTOR SYSTEMS
William J. Snyder *In* NASA, Washington, NASA/Army Rotorcraft Technology. Volume 3: Systems Integration, Research Aircraft, and Industry Feb. 1988 p 1235-1273 (For primary document see N88-16650 09-01)
Avail: NTIS HC A17/MF A01 CSCL 01C

N88-16657*# Textron Bell Helicopter, Fort Worth, Tex.
AN OVERVIEW OF KEY TECHNOLOGY THRUSTS AT BELL HELICOPTER TEXTRON

James H. Harse, Jing G. Yen, and Rodney S. Taylor *In* NASA, Washington, NASA/Army Rotorcraft Technology. Volume 3: Systems Integration, Research Aircraft, and Industry Feb. 1988 p 1279-1340 (For primary document see N88-16650 09-01)
Avail: NTIS HC A17/MF A01 CSCL 01C

N88-16658*# Boeing Vertol Co., Philadelphia, Pa.
ROTORCRAFT TECHNOLOGY AT BOEING VERTOL: RECENT ADVANCES
John Shaw, Leo Dadone, and Robert Wiesner *In* NASA, Washington, NASA/Army Rotorcraft Technology. Volume 3: Systems Integration, Research Aircraft, and Industry Feb. 1988 p 1341-1394 (For primary document see N88-16650 09-01)
Avail: NTIS HC A17/MF A01 CSCL 01C

N88-16659*# Sikorsky Aircraft, Stratford, Conn.
RECENT SIKORSKY R AND D PROGRESS
In NASA, Washington, NASA/Army Rotorcraft Technology. Volume 3: Systems Integration, Research Aircraft, and Industry Feb. 1988 p 1395-1449 (For primary document see N88-16650 09-01)
Avail: NTIS HC A17/MF A01 CSCL 01C

N88-16660*# McDonnell-Douglas Helicopter Co., Mesa, Ariz.
MCDONNELL DOUGLAS HELICOPTER COMPANY INDEPENDENT RESEARCH AND DEVELOPMENT: PREPARING FOR THE FUTURE
Allen C. Haggerty *In* NASA, Washington, NASA/Army Rotorcraft Technology. Volume 3: Systems Integration, Research Aircraft, and Industry Feb. 1988 p 1450-1481 (For primary document see N88-16650 09-01)
Avail: NTIS HC A17/MF A01 CSCL 01C

N88-17069# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio. Flight Dynamics Lab.
A NEW LOOK AT THE USE OF LINEAR METHODS TO PREDICT AIRCRAFT DYNAMIC RESPONSE TO TAXI OVER BOMB DAMAGED AND REPAIRED AIRFIELDS
James J. Olsen *In* Shock and Vibration Information Center The Shock and Vibration Bulletin. Part 4: Structural Dynamics and Modal Test and Analysis Jan. 1987 p 65-82 (For primary document see N88-17062 09-39)
Avail: NTIS HC A07/MF A01 CSCL 01C

N88-17252*# Texas Instruments, Inc., Dallas.
ROBOTIC AIR VEHICLE. BLENDING ARTIFICIAL INTELLIGENCE WITH CONVENTIONAL SOFTWARE
Christa McNulty, Joyce Graham, and Paul Roewer *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 335-340 (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 01C

N88-17433# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Cologne (West Germany). Inst. fuer Flugmechanik.
FLIGHT TEST TECHNIQUE, ILLUSTRATED BY ADVANCED TECHNOLOGIES TESTING AIRCRAFT SYSTEM (ATTAS) [FLUGVERSUCHSTECHNIK AM BEISPIEL ATTAS]
Peter Hamel and Heinz Winter *In its* Scientific Colloquium in Honor of Prof. Dr. Rer. Nat. Hermann L. Jordan Jun. 1987 p 9-36 In GERMAN (For primary document see N88-17432 09-70)
Avail: NTIS HC A07/MF A01; DFVLR, Cologne, Fed. Republic of Germany DM 29

06 AIRCRAFT INSTRUMENTATION

Includes cockpit and cabin display devices; and flight instruments.

For related information see also *19 Spacecraft Instrumentation* and *35 Instrumentation and Photography.*

N88-16654*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
AVIONICS SYSTEMS INTEGRATION TECHNOLOGY
George Stech and James R. Williams *In* NASA, Washington, NASA/Army Rotorcraft Technology. Volume 3: Systems Integration, Research Aircraft, and Industry Feb. 1988 p 1189-1210 (For primary document see N88-16650 09-01)
Avail: NTIS HC A17/MF A01 CSCL 01D

N88-16655*# Army Research and Technology Labs., Fort Eustis, Va. Aviation Applied Technology Directorate.
INTEGRATED DIAGNOSTICS
Roger J. Hunthausen *In* NASA, Washington, NASA/Army Rotorcraft Technology. Volume 3: Systems Integration, Research Aircraft, and Industry Feb. 1988 p 1211-1230 (For primary document see N88-16650 09-01)
Avail: NTIS HC A17/MF A01 CSCL 01D

07 AIRCRAFT PROPULSION AND POWER

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and onboard auxilliary power plants for aircraft.

For related information see also *20 Spacecraft Propulsion and Power, 28 Propellants and Fuels,* and *44 Energy Production and Conversion.*

N88-16697*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
AEROPROPULSION '87. SESSION 1: AEROPROPULSION MATERIALS RESEARCH
Nov. 1987 121 p Conference held in Cleveland, Ohio, 17-19 Nov. 1987 Submitted for publication
(NASA-CP-10003-Sess-1; E-3798-Sess-1; NAS 1.55:10003-Sess-1) Avail: NTIS HC A06/MF A01 CSCL 21E

Topics addressed include: aeropropulsion research and technology impact; high temperature polymer matrix composites; creep and fatigue effects; self-lubricating coatings; and ceramics for engines. For individual titles, see N88-16698 through N88-16704.

N88-16698*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
IMPACT AND PROMISE OF NASA AEROPROPULSION TECHNOLOGY
Neal T. Saunders and David N. Bowditch *In its* Aeropropulsion '87. Session 1: Aeropropulsion Materials Research Nov. 1987 30 p (For primary document see N88-16697 09-07)
Avail: NTIS HC A06/MF A01 CSCL 21E

The aeropropulsion industry in the United States has established an enviable record of leading the world in aeropropulsion for commercial and military aircraft. The NASA aeropropulsion propulsion program (primarily conducted through the Lewis Research Center) has significantly contributed to that success through research and technology advances and technology demonstrations such as the Refan, Engine Component Improvement, and the Energy Efficient Engine Programs. Some past NASA contributions to engines in current aircraft are reviewed, and technologies emerging from current research programs for the aircraft of the 1990's are described. Finally, current program thrusts toward improving propulsion systems in the 2000's for subsonic commercial aircraft and higher speed aircraft such as the High-Speed Civil Transport and the National Aerospace Plane (NASP) are discussed. Author

N88-16699*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
LEWIS MATERIALS RESEARCH AND TECHNOLOGY: AN OVERVIEW c81
Salvatore J. Grisaffe *In its* Aeropropulsion '87. Session 1: Aeropropulsion Materials Research Nov. 1987 8 p (For primary document see N88-16697 09-07)
Avail: NTIS HC A06/MF A01 CSCL 05A

The Materials Division at the Lewis Research Center has a long record of contributions to both materials and process technology as well as to the understanding of key high-temperature phenomena. An overview of the division staff, facilities, past history, recent progress, and future interests is presented. Author

N88-16700*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
HIGH TEMPERATURE POLYMER MATRIX COMPOSITES c24
Michael A. Meador *In its* Aeropropulsion '87. Session 1: Aeropropulsion Materials Research Nov. 1987 15 p (For primary document see N88-16697 09-07)
Avail: NTIS HC A06/MF A01 CSCL 11D

With the increased emphasis on high performance aircraft the need for lightweight, thermal/oxidatively stable materials is growing. Because of their ease of fabrication, high specific strength, and ability to be tailored chemically to produce a variety of mechanical and physical properties, polymers and polymer matrix composites present themselves as attractive materials for a number of aeropropulsion applications. In the early 1970s researchers at the NASA Lewis Research Center developed a highly processable, thermally stable (600 F) polyimide, PMR-15. Since that time, PMR-15 has become commercially available and has found use in military aircraft, in particular, the F-404 engine for the Navy's F/A-18 strike fighter. The NASA Lewis contributions to high temperature polymer matrix composite research will be discussed as well as current and future directions. Author

N88-16701*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
CREEP AND FATIGUE RESEARCH EFFORTS ON ADVANCED MATERIALS c39
John Gayda *In its* Aeropropulsion '87. Session 1: Aeropropulsion Materials Research Nov. 1987 18 p (For primary document see N88-16697 09-07)
Avail: NTIS HC A06/MF A01 CSCL 20K

Two of the more important materials problems encountered in turbine blades of aircraft engines are creep and fatigue. To withstand these high-temperature phenomena modern engines utilize single-crystal, nickel-based superalloys as the material of choice in critical applications. Recent research activities at Lewis on single-crystal blading material as well as future research initiatives on metal matrix composites related to creep and fatigue are discussed. The goal of these research efforts is improving the understanding of microstructure-property relationships and thereby guide material development. Author

N88-16702*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
DEVELOPMENT OF A NEW GENERATION OF HIGH-TEMPERATURE c24
Pamela K. Brindley *In its* Aeropropulsion '87. Session 1: Aeropropulsion Materials Research Nov. 1987 15 p (For primary document see N88-16697 09-07)
Avail: NTIS HC A06/MF A01 CSCL 11D

There are ever-increasing demands to develop low-density materials that maintain high strength and stiffness properties at elevated temperatures. Such materials are essential if the requirements for advanced aircraft, space power generation, and space station plans are to be realized. Metal matrix composites and intermetallic matrix composites are currently being investigated at NASA Lewis for such applications because they offer potential increases in strength, stiffness, and use temperature at a lower density than the most advanced single-crystal superalloys presently available. Today's discussion centers around the intermetallic matrix composites proposed by Lewis for meeting advanced aeropropulsion requirements. The fabrication process currently being used at Lewis to produce intermetallic matrix composites will be reviewed, and the properties of one such composite, SiC/Ti3Al+Nb, will be presented. In addition, the direction of future research will be outlined, including plans for enhanced fabrication of aluminide composites by the arc spray technique and fiber development by the floating-zone process. Author

N88-16703*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SELF-LUBRICATING COATINGS FOR HIGH-TEMPERATURE APPLICATIONS c27
Harold E. Sliney *In its* Aeropropulsion '87. Session 1: Aeropropulsion Materials Research Nov. 1987 13 p (For primary document see N88-16697 09-07)
Avail: NTIS HC A06/MF A01 CSCL 11C

Some present-day aeropropulsion systems impose severe demands on the thermal and oxidative stability of lubricant, bearing, and seal materials. These demands will be much more severe for operational systems around the turn of the century. Solid lubricants with maximum temperature capabilities of about 1100 C are known. Unfortunately, none of the solid lubricants with the highest temperature capabilities are effective below approximately 400 C. However, research shows that silver and stable fluorides, such as calcium and barium fluoride act synergistically to provide lubrication from below room temperature to approximately 900 C. Plasma-sprayed, self-lubricating composite coatings that were developed at Lewis are described. Background information is given on coatings, designed as PS100 and PS101, that contain the solid lubricants in a Nichrome matrix. These coatings have low friction coefficients over a wide temperature range, but they have inadequate wear resistance for some long-duration applications. Wear resistance was dramatically improved in a recently developed coating PS200, by replacing the Nichrome matrix material with metal-bonded chromium carbide containing dispersed silver and calcium fluoride/barium fluoride eutectic (CaF2/BaF2). The lubricants control friction and the carbide matrix provides excellent wear resistance. Successful tests of these coatings are discussed. Author

N88-16704*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
CERAMICS FOR ENGINES c27
James D. Kiser, Stanley R. Levine, and James A. DiCarlo *In its* Aeropropulsion '87. Session 1: Aeropropulsion Materials Research Nov. 1987 18 p (For primary document see N88-16697 09-07)
Avail: NTIS HC A06/MF A01 CSCL 11C

Structural ceramics were under nearly continuous development for various heat engine applications since the early 1970s. These efforts were sustained by the properties that ceramics offer in the areas of high-temperature strength, environmental resistance, and low density and the large benefits in system efficiency and performance that can result. The promise of ceramics was not realized because their brittle nature results in high sensitivity to microscopic flaws and catastrophic fracture behavior. This translated into low reliability for ceramic components and thus limited their application in engines. For structural ceramics to successfully make inroads into the terrestrial heat engine market requires further advances in low cost, net shape fabrication of high reliability components, and improvements in properties such as toughness, and strength. These advances will lead to very limited use of ceramics in noncritical applications in aerospace engines. For critical aerospace applications, an additional requirement is that the components display markedly improved toughness and noncatastrophic or graceful fracture. Thus the major emphasis is on fiber-reinforced ceramics. Author

N88-16705# Naval Postgraduate School, Monterey, Calif.
AN INVESTIGATION INTO THE FEASIBILITY OF USING A DUAL-COMBUSTION MODE RAMJET IN A HIGH MACH NUMBER TACTICAL MISSILE M.S. Thesis

Clifford B. Vaught Sep. 1987 84 p
(AD-A186906) Avail: NTIS HC A05/MF A01 CSCL 21E

An investigation into the feasibility of using a solid fuel, dual combustion mode ramjet in a high Mach number tactical missile was conducted to determine the regimes where this propulsion plant might be superior to a conventional solid fuel ramjet. The results of the study show that at Mach 6, 80,000 feet, with a temperature rise combustion efficiency of 90 percent, the DMRJ performance exceeded that of the SFRJ by 20 percent at near stoichiometric overall fuel-to-air ratios, neglecting mixing losses in the supersonic combustor. It also appears that eta delta T must be greater than 70 percent in order for the DMRJ to out-perform the conventional SFRJ. GRA

N88-16706# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Systems and Logistics.
TURBINE ENGINE MONITORING SYSTEMS: CAN THEY BENEFIT COMPONENT IMPROVEMENT PROGRAM MANAGEMENT? M.S. Thesis
Len J. Neist Sep. 1987 72 p
(AD-A186992; AFIT/GLM/LSM/87S-51) Avail: NTIS HC A04/MF A01 CSCL 21E

The purpose is to verify if the data collected by Turbine Engine Monitoring Systems (TEMS) could benefit an engine's Component Improvement Program (CIP) management. The initial plan was to identify and assess any benefits by comparing an engine with a CIP (PWA TF30) but not TEMS against an engine with a CIP and a TEMS (GE TF34). This was not possible, however, because the TEMS data were not being used to assist with TF34 CIP management due to the lack of a Central Data Base to collate and transform the data. The engine duty cycle was identified as the key to many important areas of a CIP, including engine component life usage and failure replication and diagnosis. As mentioned above, the current methods used to identify an engine's duty cycle lack the accuracy and reliability required to manage modern gas turbine engines. The main thrust of the recommendations is that a central data base be established so that the TF34 CIP manager can utilize TEMS data. In addition, a comparison use cost analysis is recommended to firmly establish the benefits to both long and short term engine management. GRA

N88-16637*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
TECHNOLOGY DEVELOPMENTS FOR A COMPOUND CYCLE ENGINE
George A. Bobula, William T. Wintucky, and J. G. Castor (Garrett Turbine Engine Co., Phoenix, Ariz.) *In* NASA, Washington, NASA/Army Rotorcraft Technology. Volume 2: Materials and Structures, Propulsion and Drive Systems, Flight Dynamics and Control, and Acoustics Feb. 1988 p 683-697 (For primary document see N88-16632 09-01)
Avail: NTIS HC A25/MF A01 CSCL 21E

N88-16638*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SMALL GAS TURBINE ENGINE TECHNOLOGY
Richard W. Niedzwiecki and Peter L. Meitner (Army Research and Technology Labs., Cleveland, Ohio.) *In* NASA, Washington, NASA/Army Rotorcraft Technology. Volume 2: Materials and Structures, Propulsion and Drive Systems, Flight Dynamics and Control, and Acoustics Feb. 1988 p 698-736 (For primary document see N88-16632 09-01)
Avail: NTIS HC A25/MF A01 CSCL 21E

N88-16639*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
THE CONVERTIBLE ENGINE: A DUAL-MODE PROPULSION SYSTEM
Jack G. McArdle *In* NASA, Washington, NASA/Army Rotorcraft Technology. Volume 2: Materials and Structures, Propulsion and Drive Systems, Flight Dynamics and Control, and Acoustics Feb. 1988 p 737-768 (For primary document see N88-16632 09-01)
Avail: NTIS HC A25/MF A01 CSCL 21E

N88-16640*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
RESULTS OF NASA/ARMY TRANSMISSION RESEARCH
John J. Coy (Army Research and Technology Labs., Cleveland, Ohio.), Dennis P. Townsend, and Harold H. Coe *In* NASA, Washington, NASA/Army Rotorcraft Technology. Volume 2: Materials and Structures, Propulsion and Drive Systems, Flight Dynamics and Control, and Acoustics Feb. 1988 p 769-801 (For primary document see N88-16632 09-01)
Avail: NTIS HC A25/MF A01 CSCL 21E

N88-17210*# Systems Control Technology, Inc., Palo Alto, Calif.
KNOWLEDGE BASED JET ENGINE DIAGNOSTICS
Timothy G. Jellison and Ronald L. DeHoff *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 25-30 (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 21E

08 AIRCRAFT STABILITY AND CONTROL

Includes aircraft handling qualities; piloting; flight controls; and autopilots.

For related information see also *05 Aircraft Design, Testing and Performance.*

N88-16707*# Integrated Systems, Inc., Palo Alto, Calif.
AIRCRAFT FLIGHT TEST TRAJECTORY CONTROL Final Contractor Report
P. K. A. Menon and R. A. Walker Jan. 1988 197 p
(Contract NAS2-11877)
(NASA-CR-179428; H-1345; NAS 1.26:179428) Avail: NTIS HC A09/MF A01 CSCL 01C

Two design techniques for linear flight test trajectory controllers (FTTCs) are described: Eigenstructure assignment and the minimum error excitation technique. The two techniques are used to design FTTCs for an F-15 aircraft model for eight different maneuvers at thirty different flight conditions. An evaluation of the FTTCs is presented. Author

N88-16708# National Aerospace Lab., Tokyo (Japan).
EXPERIMENTAL STUDY ON THE EFFECT OF FIBER ORIENTATION ON FLUTTER CHARACTERISTICS OF HIGH-ASPECT-RATIO TRANSPORT WING
Hiroshi Ejiri, Jiro Nakamichi, Takao Kikuchi, and Masakatsu Minegishi 1987 13 p In JAPANESE; ENGLISH summary
(NAL-TR-936; ISSN-0389-4010) Avail: NTIS HC A03/MF A01

The basic effects of aeroelastic tailoring on flutter velocity are investigated. Six different models of high aspect ratio swept back wings were designed. The models consisted of composite plate-spars and wing sections of balsa wood. The dominant lamination angle of each spar was changed in a parametric manner. A vibration test was performed for each model. The frequencies and the vibration modes were measured to check the variations of the vibration characteristics due to differences of the laminate angle of the spars. The flutter tests were conducted in a low-speed tunnel and the hard flutter points are found for all models. It was shown that the flutter velocity of a model which was the wash-in type of the first bending mode is larger by 50 percent than that of a model of which the first bending mode is the wash-out type. Author

N88-16709# National Aerospace Lab., Tokyo (Japan).
EFFECT OF AN OPTIMIZED FIBER ORIENTATION ON TRANSONIC FLUTTER CHARACTERISTICS OF A HIGH-ASPECT-RATIO COMPOSITE WING
K. Isogai, H. Ejiri, T. Kikuchi, K. Yamane, I. Kumakura, T. Sotozaki,

M. Minegishi, and Y. Noguchi 1987 12 p In JAPANESE; ENGLISH summary
(NAL-TR-930; ISSN-0389-4010) Avail: NTIS HC A03/MF A01

The feasibility is examined of using a direct search method, which does not depend on the flutter velocity derivative, to find the optimum fiber orientations which maximize the flutter velocity of a composite wing. The Sequential Simplex Method, as one candidate for such a method, was applied to the design of a transonic flutter model of a high-aspect-ratio transport wing, and was proven to be very effective in finding the optimum fiber orientation to give the maximum flutter velocity. The experimental verification of this has also been conducted in the National Aerospace Laboratory (NAL) 0.6 m x 0.6 m transonic blow down tunnel, by flutter tests with two kinds of models; i.e., one with an optimum fiber orientation, and one without. The experimental results have shown that the flutter velocities of the optimized model are about 60 percent higher than those of the non-optimized model over the entire transonic Mach number range tested. Author

N88-16628*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
A SUMMARY OF RECENT NASA/ARMY CONTRIBUTIONS TO ROTORCRAFT VIBRATIONS AND STRUCTURAL DYNAMICS TECHNOLOGY
Raymond G. Kvaternik, Felton D. Bartlett, Jr., and John H. Cline (Army Aerostructures Directorate, Hampton, Va.) *In* NASA, Washington, NASA/Army Rotorcraft Technology. Volume 1: Aerodynamics, and Dynamics and Aeroelasticity Feb. 1988 p 71-179 (For primary document see N88-16625 09-01)
Avail: NTIS HC A23/MF A01 CSCL 01C

N88-16631*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
ROTORCRAFT AEROELASTIC STABILITY
Robert A. Ormiston, William G. Warmbrodt, Dewey H. Hodges, and David A. Peters (Georgia Inst. of Tech., Atlanta.) *In* NASA, Washington, NASA/Army Rotorcraft Technology. Volume 1: Aerodynamics, and Dynamics and Aeroelasticity Feb. 1988 p 353-529 (For primary document see N88-16625 09-01)
Avail: NTIS HC A23/MF A01 CSCL 01C

N88-16642*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
HELICOPTER MATHEMATICAL MODELS AND CONTROL LAW DEVELOPMENT FOR HANDLING QUALITIES RESEARCH
Robert T. N. Chen, J. Victor Lebacqz, Edwin W. Aiken, and Mark B. Tischler (Army Aviation Systems Command, Moffett Field, Calif.) *In* NASA, Washington, NASA/Army Rotorcraft Technology. Volume 2: Material and Structures, Propulsion and Drive Systems, Flight Dynamics and Control, and Acoustics Feb. 1988 p 837-899 (For primary document see N88-16632 09-01)
Avail: NTIS HC A25/MF A01 CSCL 01C

N88-16643*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ROTORCRAFT FLIGHT-PROPULSION CONTROL INTEGRATION
James R. Mihaloew, Mark G. Ballin, and D. G. C. Ruttledge (Sikorsky Aircraft, Stratford, Conn.) *In* NASA, Washington, NASA/Army Rotorcraft Technology. Volume 2: Materials and Structures, Propulsion and Drive Systems, Flight Dynamics and Control, and Acoustics Feb. 1988 p 900-928 (For primary document see N88-16632 09-01)
Avail: NTIS HC A25/MF A01 CSCL 01C

N88-16645*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
ROTORCRAFT HANDLING-QUALITIES DESIGN CRITERIA DEVELOPMENT
Edwin W. Aiken, J. Victor Lebacqz, Robert T. N. Chen, and David L. Key (Army Aviation Systems Command, Moffett Field, Calif.) *In* NASA, Washington, NASA/Army Rotorcraft Technology. Volume 2: Materials and Structures, Propulsion and Drive Systems, Flight Dynamics and Control, and Acoustics Feb. 1988 p 948-998 (For primary document see N88-16632 09-01)
Avail: NTIS HC A25/MF A01 CSCL 01C

N88-16647*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
IDENTIFICATION AND PROPOSED CONTROL OF HELICOPTER TRANSMISSION NOISE AT THE SOURCE
John J. Coy, Robert F. Handschuh, David G. Lewicki (Army Research and Technology Labs., Cleveland, Ohio.), Ronald G. Huff, Eugene A. Krejsa, and Allan M. Karchmer *In* NASA, Washington, NASA/Army Rotorcraft Technology. Volume 2: Materials and Structures, Propulsion and Drive Systems, Flight Dynamics and Control, and Acoustics Feb. 1988 p 1045-1065 Previously announced as N87-16816 (For primary document see N88-16632 09-01)
Avail: NTIS HC A25/MF A01 CSCL 01C

09 RESEARCH AND SUPPORT FACILITIES (AIR)

Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tubes; and aircraft engine test stands.

For related information see also *14 Ground Support Systems and Facilities (Space).*

N88-16710# Aeronautical Research Labs., Melbourne (Australia).
CALIBRATION OF THE ARL (AERONAUTICAL RESEARCH LABORATORIES) RAIN AND ICING FACILITY
P. N. Doogood Jan. 1987 21 p
(Grant ARL-AERO-PROP-TM-442)
(AD-A186776; DODA-AR-004-527) Avail: NTIS HC A03/MF A01 CSCL 14B

A rain and icing test facility was set up at the Aeronautical Research Laboratories in the early seventies to test anti-icing systems for aircraft engine air intakes. This report describes modifications made to facility to meet a specific test requirement and analyses the effect that these have made on its performance. GRA

N88-16711# Karlsruhe Univ. (West Germany). Sonderforschungsbereich 210.
WIND TUNNEL MODELING TECHNIQUES [MODELLIERUNGS-TECHNIKEN IM WINDKANAL]
J. Maier-Erbacher and Th. Elsaesser Nov. 1986 87 p In GERMAN
(KU-SFB-210/E/33; ETN-88-91054) Avail: NTIS HC A05/MF A01

Wind tunnel measurements were performed in order to simulate an atmospheric boundary layer. The requirements for the simulation of the natural boundary, wind tunnel techniques, and the Aylesbury comparative experiment are outlined. The required boundary layer (scale 1:100) was simulated in a 10 m long wind tunnel using the roughness-vortex-threshold technique. The boundary layer parameters can be systematically modified by simulation techniques. The simulation of the degree of turbulence is difficult with standard techniques and requires active production mechanisms at the tunnel entrance. The measured average pressure coefficients agree well with results from other wind tunnels. Larger deviations are found for the coefficients of the fluctuating pressures. Proposals for a better comparison with other wind tunnel data and with natural data are given. ESA

N88-16712# National Aerospace Lab., Amsterdam (Netherlands). Aerodynamics Dept.
THE WIND TUNNEL AS A YARDSTICK FOR AIRCRAFT DESIGN
A. Elsenaar Apr. 1985 20 p In DUTCH; ENGLISH summary
Presented at the NVvL-VSV Symposium on Recente Ontwikkelingen op Aerodynamisch Gebied, Delft, Netherlands, 26

Apr. 1985
(NLR-MP-85032-U; ETN-88-91325) Avail: NTIS HC A03/MF A01

The accuracy of the measurement of drag is used to illustrate problems in wind tunnel testing, like balance performance, determination of angle of incidence, wall and support interference, scale effects, and engine simulation. Flexible walls, cryogenic testing, and the application of turbine powered engine simulators are discussed. The increasing role of computers to determine or eliminate wind tunnel corrections is noted. It is concluded that the wind tunnel and the computer are essentially complementary in aerodynamic design and verification and in data reduction and data handling. ESA

N88-16713# Institut Franco-Allemand de Recherches, St. Louis (France).
VELOCITY INTERFEROMETRY IN SHOCK TUBES AND SHOCK TUNNELS
G. Smeets and G. Mathieu 3 Mar. 1987 10 p
(ISL-CO-203/87; ETN-88-91638) Avail: NTIS HC A02/MF A01

The application of laser velocimetry to the highly instationary and short duration flows in shock tubes by means of a spectrometric detection of the Doppler shift is introduced. A phase stabilized Michelson interferometer enables a continuous velocity recording in real time and with a time resolution in the microsecond range. As this technique needs a continuous scattered light output and a correspondingly high tracer number density, cigarette smoke was used for seeding in the first experiments. As, however, smoke particles evaporate at temperatures greater than 500 C, a seeding procedure with soot from hydrocarbon gas pyrolysis was developed. It is shown that soot formed in this way can be stored at the tube walls and be homogeneously mixed into the shock tube flow in subsequent experiments, thus enabling Doppler measurements also in cases of shock heating to much higher temperatures. ESA

N88-16714# Eidgenoessisches Flugzeugwerk, Emmen (Switzerland). Abteilung Versuchs- und Forschungsanlage.
TRANSONIC WIND TUNNEL CALIBRATION 1986: FORCE MEASUREMENTS ON THREE ONERA-C5 MODELS AND THREE HALF SPHERE CYLINDER CALIBRATION BODIES IN THE F+W TRANSONIC TEST SECTION
Heinz Blaettler 19 Jan. 1987 138 p In GERMAN; ENGLISH summary
(F+W-FO-1854; ETN-88-91687) Avail: NTIS HC A07/MF A01

Force measurements were taken on three C5 calibration models and three half-sphere-cylinder calibration bodies of different size to establish the effect of blockage on drag. The C5 model is a body of revolution with the same distribution of cross-sectional area as a civil airplane model. The blockage-ratio of the three models is: 0.5 percent; 1 percent and 2 percent. Good coincidence with previous measurements are observed with the 0.5 percent and 1 percent models. Measurements in the region of Ma less than or equal 0.5 diverge considerably from measurements taken elsewhere. ESA

N88-16715# Eidgenoessisches Flugzeugwerk, Emmen (Switzerland). Abteilung Aerodynamik und Flugmechanik.
INFLUENCE OF THE WALL BOUNDARY LAYER ON FORCE MEASUREMENTS ON HALF MODELS IN THE TRANSONIC WIND TUNNEL
Philippe Blatter and Felix Hirt 21 Apr. 1987 89 p Partly in GERMAN and ENGLISH
(F+W-TF-1876; ETN-88-91688) Avail: NTIS HC A05/MF A01

Characteristics of the lateral wall boundary layer in relation to the Mach number are experimentally determined and their effect on systematic measuring errors on a half model is investigated. A linear flow model together with the boundary layer characteristics is used to determine the optimal thickness of the lateral plate. ESA

N88-16716# Eidgenoessisches Flugzeugwerk, Emmen (Switzerland). Abteilung Aerodynamik und Flugmechanik.
ARIANE 4, LONG VERSION: PRESSURE DISTRIBUTION MEASUREMENTS ON TWO MODELS OF DIFFERENT SCALE OF THE ARIANE 4 NOSE FAIRINGS IN THE TRANSONIC TUNNEL OF F+W EMMEN (SWITZERLAND) WITH VARYING TUNNEL CONFIGURATIONS. COMPARISON WITH MEASUREMENTS TAKEN AT MODANE (FRANCE) AND WITH CALCULATIONS AFTER THE EULER METHOD
Heinz Blaettler 15 May 1987 83 p In GERMAN; ENGLISH summary
(F+W-TF-1878; ETN-88-91689) Avail: NTIS HC A05/MF A01

Pressure measurements of the Ariane fairings were taken in a transonic wind tunnel. Four and eight slot sections were used. Comparison of results of the measurements in the eight slot section show better coincidence with measurements taken elsewhere than to measurements taken with the four-slot configuration. This confirms measurements taken with other calibration models. ESA

N88-16717*# Eloret Corp., Sunnyvale, Calif.
UPGRADING OF NASA-AMES HIGH-ENERGY HYPERSONIC FACILITIES: A STUDY Final Technical Report, 1 Oct. 1987 - 31 Jan. 1988
Charles E. Shepard and William C. A. Carlson 24 Feb. 1988 80 p
(Contract NCC2-503)
(NASA-CR-182475; NAS 1.26:182475) Avail: NTIS HC A05/MF A01 CSCL 14B

This study reviews facility capabilities of NASA, Ames Research Center to simulate hypersonic flight with particular emphasis on arc heaters. Scaling laws are developed and compared with ARCFLO II calculations and with existing data. The calculations indicate that a 300 MW, 100 atmosphere arc heater is feasible. Recommendations for the arc heater, which will operate at voltages up to 50 kilovolts, and the associated elements needed for a test facility are included. Author

N88-16651*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
STATUS OF NASA/ARMY ROTORCRAFT RESEARCH AND DEVELOPMENT PILOTED FLIGHT SIMULATION
Gregory W. Condon and Terrence D. Gossett (Army Aviation Systems Command, Moffett Field, Calif.) *In* NASA, Washington, NASA/Army Rotorcraft Technology. Volume 3: Systems Integration, Research Aircraft, and Industry Feb. 1988 p 1119-1153 (For primary document see N88-16650 09-01)
Avail: NTIS HC A17/MF A01 CSCL 14B

N88-17059# Sandia National Labs., Albuquerque, N. Mex.
HIGH-VELOCITY REVERSE BALLISTIC ROCKET SLED TESTING AT SANDIA NATIONAL LABORATORIES
R. D. M. Tachau *In* Shock and Vibration Information Center The Shock and Vibration Bulletin. Part 2: Instrumentation, Shock Analysis and Shock Testing Jan. 1987 p 99-104 Previously announced as N87-19423 (For primary document see N88-17053 09-39)
Avail: NTIS HC A08/MF A01 CSCL 14B

12 ASTRONAUTICS (GENERAL)

For extraterrestrial exploration see *91 Lunar and Planetary Exploration.*

N88-16718# European Space Agency, Paris (France).
ESA BULLETIN NO. 8
Bruce Battrick, ed. and T. Duc Guyenne, ed. Feb. 1977 76 p
(ETN-87-90513) Avail: NTIS HC A05/MF A01

The GEOS apogee boost motor, ESA scientific projects; the Space Telescope; infrared astronomy; aircraft simulation of Spacelab; ESA's policy of international relations; antenna technology; coordinated use of European test facilities; and

measures taken to avoid pogo effects on Ariane are discussed. For individual titles, see N88-16719 through N88-16727.

N88-16719# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). GEOS Div.
A EUROPEAN APOGEE BOOST MOTOR FOR GEOS **c20**
J. A. Steinz *In its* ESA Bulletin No. 8 Feb. 1977 p 3-7 (For primary document see N88-16718 09-12)
Avail: NTIS HC A05/MF A01

A solid-propellant apogee boost motor was developed for the geostationary scientific satellite GEOS. It forms an integral part of the satellite and is used to inject it into geostationary orbit from the initial elliptical transfer orbit provided by the Thor-Delta launch vehicle. The motor's design, development, and qualification program, and ground test firings in air and in vacuum are described. The 306 kg GEOS motor produces 23,000 Newtons of thrust and accounts for more than half the satellite's total weight.
Author (ESA)

N88-16720# European Space Agency, Paris (France). Dept. of Future Scientific Programs.
STUDIES FOR FUTURE SCIENTIFIC PROJECTS
E. Peytremann *In its* ESA Bulletin No. 8 Feb. 1977 p 8-12 (For primary document see N88-16718 09-12)
Avail: NTIS HC A05/MF A01

A Sun-Earth Observatory and Climatology Satellite, (SEOCS) a Grazing-Incidence Solar Telescope (GRIST) for Spacelab, an Extreme Ultraviolet and X-Ray Survey Satellite (EXUV), and a Space Astronometry mission are discussed. The projects are alternatives to the Space Telescope and Out-of-Ecliptic missions, joint NASA-ESA projects which await approval by U.S. authorities. Smaller projects (solar probe, dumb bell configuration, transient X-ray sources, IR satellite, Spacelab superconducting magnetic facility, and life sciences) are mentioned. Author (ESA)

N88-16721# European Space Agency, Paris (France). Dept. of Future Scientific Programs.
THE 2.4 m SPACE TELESCOPE AND ESA PARTICIPATION IN THE PROGRAM **c89**
V. Manno *In its* ESA Bulletin No. 8 Feb. 1977 p 13-17 (For primary document see N88-16718 09-12)
Avail: NTIS HC A05/MF A01

The Space Telescope program is described and ESA participation is summarized. This comprises the Faint Object Camera (FOC) and associated Imaging Photon Counting System (IPCS), the solar arrays and deployment mechanisms, and support of the activities of the Scientific Center established to guide and perform the scientific program of the Space Telescope in its operational phase. In return for this participation, ESA is guaranteed 15 percent of the observing time of the Space Telescope during 10 years of space operations. Author (ESA)

N88-16722# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Space Science Dept.
INFRARED ASTRONOMY: WHY AND HOW? **c89**
J. E. Beckmann *In its* ESA Bulletin No. 8 Feb. 1977 p 18-23 (For primary document see N88-16718 09-12)
Avail: NTIS HC A05/MF A01

The prospects for spaceborne infrared astronomy are considered. Studies of the cosmic background radiation, investigations of the physics of the interstellar medium and of external galaxies, and ionic line detection are proposed. Technological developments such as heterodyne techniques are discussed. Author (ESA)

N88-16723# European Space Agency, Porz-Wahn (West Germany).
ASSESS-2: AN AIRCRAFT SIMULATION OF SPACELAB **c16**
J. Dewaard and D. J. Shapland (European Space Agency, Paris, France) *In its* ESA Bulletin No. 8 Feb. 1977 p 24-28 (For primary document see N88-16718 09-12)
Avail: NTIS HC A05/MF A01

A flight program using full-scale mock-ups on an aircraft was conducted to exercise the management and integration schemes and organizations proposed for the First Spacelab Payload and subsequent joint Spacelab flights. The flights also evaluated the ground-support equipment required to support Spacelab and its payloads; developed experiment test and interface specifications; and appraised experimenter participation and payload-specialist training. Author (ESA)

N88-16724# European Space Agency, Paris (France). Dept. of International and Legal Affairs.
A POLICY FOR INTERNATIONAL RELATIONS **c84**
H. Kaltenecker *In its* ESA Bulletin No. 8 Feb. 1977 p 29-44 (For primary document see N88-16718 09-12)
Avail: NTIS HC A05/MF A01

The relations between ESA and its organs and the governments and institutions of non-member states and international organizations are discussed. Author (ESA)

N88-16725# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Space Communications Div.
EUROPEAN DEVELOPMENTS IN ANTENNA TECHNOLOGY **c32**
J. Aasted *In its* ESA Bulletin No. 8 Feb. 1977 p 48-53 (For primary document see N88-16718 09-12)
Avail: NTIS HC A05/MF A01

Development work to design the antennas for current and future generations of satellites, the methods employed to verify designs, and the research needed to overcome limitations are discussed.
Author (ESA)

N88-16726# European Space Agency, Paris (France). Directorate of Planning and Future Programs.
COORDINATED USE OF EUROPEAN TEST FACILITIES **c14**
R. Broezel *In its* ESA Bulletin No. 8 Feb. 1977 p 54-57 (For primary document see N88-16718 09-12)
Avail: NTIS HC A05/MF A01

The utility of coordinating satellite test facilities used by ESA and its partners is discussed. Compatibility between test centers is described. Author (ESA)

N88-16727# Centre National d'Etudes Spatiales, Paris (France). Ariane Project Team.
LAUNCH VEHICLE VIBRATION: MEASURES TAKEN TO AVOID POGO ON ESA'S ARIANE LAUNCH VEHICLE **c15**
Ph. Couillard and W. G. Naumann *In its* ESA Bulletin No. 8 Feb. 1977 p 58-60 (For primary document see N88-16718 09-12)
Avail: NTIS HC A05/MF A01

The pogo phenomenon is described and studies of the pogo effect conducted to design the Ariane pogo correction system (PCS) are outlined. The PCS consists of several correction devices which form part of the launch vehicle feed lines and ancillary equipment. Studies and tests indicate that it should be possible to eliminate pogo instabilities on Ariane by employing the PCS. It is intended to use the PCS on the launch vehicle's first and second stages only, since it is demonstrated that there is much less risk of vibrational coupling occurring during firing of the vehicle's third stage. Author (ESA)

N88-16728# European Space Agency, Paris (France).
ESA BULLETIN NO. 10
Bruce Battrick, ed. and T. Duc Guyenne, ed. Aug. 1977 82 p Partly in ENGLISH and FRENCH
(ETN-87-90514) Avail: NTIS HC A05/MF A01

Specialist support to ESA projects; the ESA technological research program; the ESA centralized management system for satellite electronic test and checkout instrumentation; technology needs for millimeter wave communication; large scale integration for onboard data processing; satellite control and stabilization;

electric propulsion; heat pipes; spacecraft mechanisms; the European space battery test center; product assurance; and spacecraft hardware testing are discussed. For individual titles, see N88-16729 through N88-16740.

N88-16729# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Groupe Technologie des Charges Utiles.
SPECIALIST SUPPORT FOR PROJECTS: ACTIVITIES, METHODS AND INFRASTRUCTURE [LE SOUTINE SPECAILISE AUX PROJET - SES ACTIVITES, SES METHODES, ET SON INFRASTRUCTURE]
J. Toussaint *In its* ESA Bulletin No. 10 Aug. 1977 p 8-12 In FRENCH (For primary document see N88-16728 09-12)
Avail: NTIS HC A05/MF A01

The role of specialists in the development of ESA projects is described. Data management and signal processing; space telecommunication; structures and thermal control; attitude and orbit control; spacecraft power supplies; and mathematical modeling are discussed. Author (ESA)

N88-16730# European Space Agency, Paris (France). Space Technology Group.
THE OBJECTIVES AND METHODS OF THE TECHNOLOGICAL RESEARCH PROGRAM
E. Slachmuylders *In its* ESA Bulletin No. 10 Aug. 1977 p 13-16 (For primary document see N88-16728 09-12)
Avail: NTIS HC A05/MF A01

The ESA technological research program involves the timely development of technologies and hardware, essential for the feasibility of a project, i.e., mission-critical technologies, and the continuous updating of space technology and engineering to enhance overall mission performance, both technical and economic. The program covers telecommunication, Earth observation, and Spacelab. Author (ESA)

N88-16731# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Data Handling and Signal Processing Div.
THE ESA CENTRALIZED MANAGEMENT SYSTEM FOR SATELLITE ELECTRONIC TEST AND CHECKOUT INSTRUMENTATION c81
J. B. Rowles *In its* ESA Bulletin No. 10 Aug. 1977 p 22-28 (For primary document see N88-16728 09-12)
Avail: NTIS HC A05/MF A01

The ESA centralized management system was instituted to predict system performances, to ensure correct matching of hardware and software constituents of each system, and to use a common logistic support organization encompassing documentation, procedures, maintenance, and operations. It is possible to define the instrumentation required at a very early stage in a project and to initiate procurement action for a well-proven system, thus reducing the risks involved in the development of the spacecraft; to achieve significant savings in capital investment, stemming from the possibility to reutilize equipment; to achieve a substantial reduction in the time needed for satellite integration and testing by using well proven testing methods and procedures; and to readily accommodate the requirements of space missions of increasing complexity at low cost and low risk by way of simple additions or modifications to existing equipment and procedures. Author (ESA)

N88-16732# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Space Communications Div.
TECHNOLOGY DEVELOPMENTS TO MEET TOMORROW'S NEED FOR HIGHER SATELLITE FREQUENCIES
G. Mica *In its* ESA Bulletin No. 10 Aug. 1977 p 29-32 (For primary document see N88-16728 09-12)
Avail: NTIS HC A05/MF A01

The need for communication satellites to use frequencies well above 10 GHz because of saturation of lower frequencies is discussed. Problems with atmospheric attenuation at these frequencies are reviewed. Antenna and ground station design are considered. Technology developments required for millimeter waves are considered. Author (ESA)

N88-16733# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Data Handling Div.
INTRODUCING NEW TECHNOLOGY INTO ONBOARD HANDLING SYSTEMS c60
M. A. Perry, P. May, and W. Walker *In its* ESA Bulletin No. 10 Aug. 1977 p 33-37 (For primary document see N88-16728 09-12)
Avail: NTIS HC A05/MF A01

The advantages of large scale integration for onboard data handling circuits are outlined. The effects of space radiation on bipolar and metal-oxide semiconductor (MOS) devices are underlined. Problems with packaging and interconnection are considered. Author (ESA)

N88-16734# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Attitude and Orbit Control Div.
CONTROL AND STABILIZATION OF ESA SATELLITES c18
D. N. Soo *In its* ESA Bulletin No. 10 Aug. 1977 p 38-43 (For primary document see N88-16728 09-12)
Avail: NTIS HC A05/MF A01

Payload and orbital factors affecting satellite attitude control are reviewed and attitude control systems design is discussed. Gravity gradient, solar stabilization, aerodynamic stabilization, magnetic stabilization, spin stabilization, momentum bias/dual spin, momentum exchange, and mass expulsion are described. Attitude control of the GEOS, Meteosat, TD-1, OTS, and MAROTS satellites is outlined. Author (ESA)

N88-16735# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Attitude and Orbit Control Div.
ELECTRIC PROPULSION: A CONTROVERSIAL MUST FOR LONG-LIVED APPLICATIONS SATELLITES c20
H. A. Pfeffer *In its* ESA Bulletin No. 10 Aug. 1977 p 44-48 (For primary document see N88-16728 09-12)
Avail: NTIS HC A05/MF A01

The rationale of station keeping, and technology and system considerations inherent in employing electric propulsion are discussed. Although it appears that what electric propulsion gives in terms of the large mass saving and the tremendous extension in satellite lifetime, it takes away through its complexity, the net result is overwhelmingly in its favor because the inherent problems are largely solved, and the mass saving can be reflected in either increased communications capability (more revenue), increased redundancy in the satellite payload (longer design life), or considerable extension of lifetime on station (spare satellite of indefinite lifetime, longer operating life). Author (ESA)

N88-16736# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Structures and Thermal Control Div.
HEAT PIPES FOR SPACE USE c34
A. Accensi and C. J. Savage *In its* ESA Bulletin No. 10 Aug. 1977 p 49-55 (For primary document see N88-16728 09-12)
Avail: NTIS HC A05/MF A01

The possibility of using heat pipes in ESA satellites which generate considerable quantities of heat in relatively compact subsystems is considered. The principles of operation of heat pipes are outlined. Variable conductance heat pipes and thermal diodes are described. Development of constant conductance heat pipes, variable conductance heat pipes, diodes, and spacecraft radiators is reviewed. Author (ESA)

N88-16737# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Structures and Thermal Control Div.
WHY MECHANISMS ARE CRITICAL TO SPACECRAFT PERFORMANCE **c18**
H. M. Briscoe *In its* ESA Bulletin No. 10 Aug. 1977 p 56-59 (For primary document see N88-16728 09-12)
Avail: NTIS HC A05/MF A01

Spacecraft mechanisms used for deployment, momentum wheels, gyroscopes, despin mechanisms, solar array drives, antenna pointing mechanisms, tape recorders, scanning and slewing mechanisms, and spin-up and ejection mechanisms are discussed. The OTS bearing and power transfer assembly, and the GEOS boom system are described. Author (ESA)

N88-16738# European Space Agency, Paris (France). Spacecraft Power Supplies Div.
THE EUROPEAN SPACE BATTERY TEST CENTER **c33**
H. J. Young and D. Goudot *In its* ESA Bulletin No. 10 Aug. 1977 p 60-65 (For primary document see N88-16728 09-12)
Avail: NTIS HC A05/MF A01

A center to provide functional support for ESA projects in matters concerning primary and secondary batteries, fuel cells, and metal-hydrogen cells was formed. Tasks include the supervision of the general evolution of terrestrial batteries, the preparation and execution of research and development programs, the space qualification of new products, participation in the work of ESA project teams, the coordination of European battery activities including consultancy in national programs, and the establishment of European battery-specification standards.
Author (ESA)

N88-16739# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Product Assurance Div.
ESTEC'S PRODUCT ASSURANCE ACTIVITIES **c38**
D. A. Nutt *In its* ESA Bulletin No. 10 Aug. 1977 p 66-71 (For primary document see N88-16728 09-12)
Avail: NTIS HC A05/MF A01

Product assurance is defined and the requirements of product assurance are outlined. The organization of product assurance at ESA's ESTEC center is described. The systems, components, and materials sections are introduced. Author (ESA)

N88-16740# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Test and Engineering Services Div.
MAJOR SPACECRAFT HARDWARE TESTING IN EUROPE **c18**
K. H. Heffels *In its* ESA Bulletin No. 10 Aug. 1977 p 72-76 (For primary document see N88-16728 09-12)
Avail: NTIS HC A05/MF A01

Vibration tests, acoustic tests, thermal balance tests, thermal vacuum tests, rapid depressurization tests, mechanical functioning tests, electromagnetic compatibility tests, magnetic tests, and physical measurements on spacecraft are described. Environmental test installations in Europe are presented. The evolution of environmental testing is discussed. Author (ESA)

N88-16741# European Space Agency, Paris (France).
ESA BULLETIN NO. 15: ARIANE, THE EUROPEAN LAUNCHER FOR THE 1980'S
Bruce Battrick, ed. and Duc Guyenne, ed. Aug. 1978 97 p Partly in ENGLISH and FRENCH
(ESA-Bulletin-No-15; ETN-87-90515) Copyright Avail: NTIS HC A05/MF A01

The Ariane launch vehicle performance, dual launch system, launch base, dynamic testing, fairing, HM-7 third stage engine, stage separation, and integration testing of the propulsion system are described. Altitude simulation of the second stage is summarized. For individual titles, see N88-16742 through N88-16754.

N88-16742# Centre National d'Etudes Spatiales, Paris (France). Ariane Project Team.
THE ARIANE LAUNCHER AND ITS PROGRESS **c15**
R. Vignelles and P. Rasse *In* ESA, ESA Bulletin No. 15: Ariane, the European Launcher for the 1980's Aug. 1978 p 10-21 In ENGLISH and FRENCH (For primary document see N88-16741 09-12)
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Ariane is a three-stage launcher with a total height of 47.4 m and weighing 208 t at lift-off, 90 percent of the mass being constituted by propellant. The structures and the payload account for 9 percent and 1 percent of the total weight, respectively. Optimization of the propellant masses of each stage and the general dimensions of the vehicle led to different diameters being adopted for the first stage and for the two upper stages. However, adoption of a bulb-shaped fairing provides sufficient usable volume to house large satellites. The only advanced propulsion technology employed is that of the third stage, where use of liquid hydrogen and liquid oxygen allows the requisite performance to be obtained without unduly increasing vehicle dimensions. Author (ESA)

N88-16743# Centre National d'Etudes Spatiales, Paris (France). Forward Planning Div.
ARIANE LAUNCH PERFORMANCE **c15**
M. Gilli *In* ESA, ESA Bulletin No. 15: Ariane, the European Launcher for the 1980's Aug. 1978 p 22-25 In ENGLISH and FRENCH (For primary document see N88-16741 09-12)
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It was decided to increase Ariane's performance margin by 100 kg over the guaranteed figure (1500 kg). The nozzles of the first-stage Viking engines were modified and, by reducing the ullage spaces, the masses of propellants carried in the first and second stages were increased by 5 t and 1 t, respectively. When the results of the engine tests were known and the stages were weighed, it proved possible to increase the guaranteed performance to 1700 kg, the difference between this and the calculated performance still being 100 kg. Author (ESA)

N88-16744# European Space Agency, Paris (France). Ariane Dept.
INCREASED PERFORMANCE FOR ARIANE **c15**
A. Lemarchand *In its* ESA Bulletin No. 15: Ariane, the European Launcher for the 1980's Aug. 1978 p 26-29 (For primary document see N88-16741 09-12)
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Ways to increase Ariane's performance are suggested. Increase in payload capability to 1950 kg by an increase in Viking 4 and 56 chamber pressures from 54 to 58 bar, and an increase in third-stage tank capacity from 8 to 10 t (tanks carrying only 9.5 t in this step) is possible. Increase in payload capability to 2300 kg by the addition of two 6 t strap-on boosters on the first stage, and full third-stage tanks (10 t) is feasible. A lengthening of the fairing by 300 to 500 mm to accommodate 2 STS/PAM-D satellites may also be envisaged. Author (ESA)

N88-16745# European Space Agency, Paris (France). Ariane Dept.
SYLDA: A DUAL-LAUNCH SYSTEM FOR ARIANE **c15**
W. Naumann *In its* ESA Bulletin No. 15: Ariane, the European Launcher for the 1980's Aug. 1978 p 28-19 (For primary document see N88-16741 09-12)
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A carrier structure capable of supporting and releasing two independent spacecraft, called SYLDA, was developed for Ariane. The SYLDA system consists of a support structure, three separation (one for each satellite and one for the structure itself). In its baseline configuration it offers the upper satellite the same volume as is available to an STS PAM-D satellite; the lower satellite can be similar in size to MARECS. The mechanical and electrical interfaces at the separation plane are the same for both satellites, and identical to those specified for the PAM-D. Separation is provided by classical Marman clamp bands released by pyrotechnically operated bolt cutters. The structure is made of an

aluminum honeycomb core, covered with carbon-fiber layers, the complete SYLDA system weighing 165 kg. It is bolted onto the conical structure of Ariane's equipment bay in place of the vehicle's standard payload adapter. As this standard adapter weighs 44 kg, the payload penalty resulting from the double-launch system is 120 kg, leaving 1580 kg of mass in transfer orbit for the 2 satellites. Author (ESA)

N88-16746# European Space Agency, Paris (France). Ariane Dept.

THE ARIANE LAUNCH BASE **c14**

C. Dana and A. Bellot *In its* ESA Bulletin No. 15: Ariane, the European Launcher for the 1980's Aug. 1978 p 30-36 (For primary document see N88-16741 09-12)

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The Ariane launch base was designed to allow developmental and operational launches to be conducted from the Quiana Space Center with the necessary safety and flexibility and with a frequency of up to four launches per year. During the initial development phase, there will be an average to 2 launches per year, but these may take place within 3 months of one another. The base's geographical position, close to the equator (5.2368 N), is a favorable factor when launching any satellite, and particularly so for a geostationary spacecraft. Launches can be made from the base on azimuths from - 10.5 deg through north to + 93.5 deg. Author (ESA)

N88-16747# Societe Europeenne de Propulsion, Vernon (France).

ALTITUDE SIMULATION TESTING OF ARIANE'S SECOND-STAGE ENGINE **c14**

G. Dorville, H. Holsten, and G. Tofahrn (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Hardthausen, West Germany) *In* ESA, ESA Bulletin No. 15: Ariane, the European Launcher for the 1980's Aug. 1978 p 37-40 (For primary document see N88-16741 09-12)

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The Viking 4 engine of Ariane's second stage underwent altitude simulation testing. Five tests were completed, 3 lasting greater than 140 sec, 2 short ones lasting less than 15 sec (total 515 sec) and 1 relight. The remaining tests should bring the total time in vacuum to 1000 sec. All the main objectives for the altitude-simulation tests on the second stage are achieved, including measurement of an engine impulse of 295.8 sec, nozzle-wall temperatures identical to those foreseen, and near-nominal combustion-engine pressures on start-up. Author (ESA)

N88-16748# Centre National d'Etudes Spatiales, Paris (France). Ariane Project Team.

MECHANICAL IN-FLIGHT ENVIRONMENT OF ARIANE PAYLOADS **c15**

M. Vedrenne *In* ESA, ESA Bulletin No. 15: Ariane, the European Launcher for the 1980's Aug. 1978 p 41-43 (For primary document see N88-16741 09-12)

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The payload environment of Ariane and the theoretical and experimental elements used to assess it are described. Acoustic, sinusoidal, and random vibrations are discussed. Shocks, combination of dimensioning loads, payload couplings, and mechanical loads on Ariane and other launchers are considered. Author (ESA)

N88-16749# Societe Nationale Industrielle Aerospatiale, Les Mureaux (France).

DYNAMIC TESTS OF THE ARIANE LAUNCH VEHICLE [ESSAIS DYNAMIQUES D'ENSEMBLE DU VEHICULE ARIANE] **c15**

M. Claramonte *In* ESA, ESA Bulletin No. 15: Ariane, the European Launcher for the 1980's Aug. 1978 p 44-50 In FRENCH (For primary document see N88-16741 09-12)

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Tests on a full scale model of Ariane were conducted. The model was subjected to longitudinal and transverse excitations for the main flight configurations. Test results show good correlation with predictions. Frequencies up to 100 Hz were used for the whole model, and up to 200 Hz for certain configurations to provide experimental data for payloads. Author (ESA)

N88-16750# European Space Agency, Paris (France).

PROJECTS UNDER DEVELOPMENT

In its ESA Bulletin No. 15: Ariane, the European Launcher for the 1980's Aug. 1978 p 51-62 (For primary document see N88-16741 09-12)

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The status of the GEOS-2, EXOSAT, Space Telescope, space sled, out-of-ecliptic mission, GTS-2, ECS, Maritime satellite, heavy satellite, Meteosat, Spacelab, and Ariane projects is summarized. Author (ESA)

N88-16751# Societe Europeenne de Propulsion, Vernon (France).

INTEGRATION TESTING OF THE PROPULSION SYSTEM OF ARIANE'S FIRST STAGE **c20**

A. Souchier *In* ESA, ESA Bulletin No. 15: Ariane, the European Launcher for the 1980's Aug. 1978 p 63-66 (For primary document see N88-16741 09-12)

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Propulsion-bay firing was conducted to study the functioning of the integrated subsystems of Ariane. The purpose was to highlight mechanical, thermal, or vibratory problems that might result from interaction between the various systems in configurations and under conditions similar to those to be expected during Ariane's flight. The tests show that the hardware performs satisfactorily. Author (ESA)

N88-16752# Centre National d'Etudes Spatiales, Paris (France). Ariane Project Team.

STAGE SEPARATION TESTING OF ARIANE **c15**

P. Gauge *In* ESA, ESA Bulletin No. 15: Ariane, the European Launcher for the 1980's Aug. 1978 p 67-70 (For primary document see N88-16741 09-12)

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Four successful Ariane stage separation tests were carried out and demonstrate proper functioning of the sequences and pyrotechnic devices and satisfactory resistance of the equipment units subject to shock. The scope of the tests (size of structures and volume of information processed) endorses the merits of laying down precise test procedures beforehand and shows how much information can be obtained from movement and shock measurements. Author (ESA)

N88-16753# Centre National d'Etudes Spatiales, Paris (France). Ariane Project Team.

THE HM-7 ENGINE OF ARIANE'S THIRD STAGE **c20**

J. Borromee and Ph. Lesage *In* ESA, ESA Bulletin No. 15: Ariane, the European Launcher for the 1980's Aug. 1978 p 71-77 (For primary document see N88-16741 09-12)

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The HM-7 engine cryogenic engine was designed to meet the propulsion requirements of Ariane's third stage. It consists of a thrust unit fed with liquid hydrogen and liquid oxygen under pressure by a turbopump, and devices to monitor, control, and condition the propellants. The whole assembly is mounted to the stage thrust frame by a gimbal and electrohydraulic actuators, which allow pitch and yaw to be controlled. Author (ESA)

N88-16754# Centre National d'Etudes Spatiales, Paris (France). Ariane Project Team.

THE ARIANE FAIRING AND ITS SEPARATION SYSTEMS **c15**

R. W. Jaeger *In* ESA, ESA Bulletin No. 15: Ariane, the European Launcher for the 1980's Aug. 1978 p 78-83 (For primary document see N88-16741 09-12)

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The Ariane fairing is described. An aft cone with an interface diameter to the equipment bay of 2.6 m opens to 3.2 m maximum diameter and is followed by a cylindrical section 4 m high that

terminates in a front-cone section with a spherical nose. The overall height of the fairing is 8.6 m. The fairing can accommodate a maximum payload diameter of 3.0 m and the useful payload volume is 40 cum. The cylindrical section and front cone are of classical metallic-frame/stringer construction; the aft cone, for reasons of radio-frequency transparency, is a kevlar-glass fiber sandwich. Access to the payload is provided by four 450 x 450 mm doors in the cylindrical section. A linear thrusting joint system is used for fairing separation. Author (ESA)

N88-16755# European Space Agency, Paris (France).
ESA BULLETIN NO. 24
Bruce Battrick, ed. and Gabrielle Levy, ed. Nov. 1980 92 p Partly in ENGLISH and FRENCH
(ISSN-0376-4265; ETN-87-90516) Copyright Avail: NTIS HC A05/MF A01

The Giotto mission; white blood cells in space (an experiment for the first Spacelab mission); the role of the L-Sat program in the evolution of European communications satellites, the Meteosat operational program, Earthnet's experience with Seasat SAR image processing; the Earthnet HCMM data-processing system at Lannion, (France); the approach to the definition of the ESA technological research program; promotion of European components for ESA projects; European industrial consortia for space projects; and Unispace 82 are discussed. For individual titles, see N88-16756 through N88-16766.

N88-16756# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).
GIOTTO: A MISSION TO HALLEY'S COMET
R. Reinhard and D. Dale *In its* ESA Bulletin No. 24 Nov. 1980 p 6-11 (For primary document see N88-16755 09-12)
Copyright Avail: NTIS HC A05/MF A01

A flyby mission to Halley's comet during its 1986 apparition is proposed. Reasons for selecting Halley; satellite design; Giotto's trajectory; and mission objectives are outlined. Author (ESA)

N88-16757# Eidgenoessische Technische Hochschule, Zurich (Switzerland). Lab. fuer Biochemie.
WHITE BLOOD CELLS IN SPACE: AN EXPERIMENT FOR THE FIRST SPACELAB MISSION c52
A. Cogoli and A. Tschopp *In* ESA, ESA Bulletin No. 24 Nov. 1980 p 24-27 (For primary document see N88-16755 09-12)
Copyright Avail: NTIS HC A05/MF A01

An experiment to test the effect of weightlessness on lumphocyte proliferation in Spacelab is proposed. It tests the reactivity of human lymphocytes in vitro, to study the efficiency of the immune system during and after space flight. Experiment hardware and design are outlined. Author (ESA)

N88-16758# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Directorate of Applications Programs.
THE ROLE OF THE L-SAT PROGRAM IN THE EVOLUTION OF EUROPEAN COMMUNICATIONS SATELLITES c18
B. L. Herdan *In its* ESA Bulletin No. 24 Nov. 1980 p 28-33 (For primary document see N88-16755 09-12)
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The telecommunications satellite market is discussed, and the L-Sat program objectives are described. It is envisaged that the L-Sat demonstration would give rise to operational satellite broadcasting missions for certain countries, to the next generation European specialized service and trunk service missions, and to operational application of the 20/30 GHz bands, all reusing the L-Sat platform if this proves to be the best solution from a technical and cost viewpoint. Author (ESA)

N88-16759# European Space Agency. Centre Spatial de Toulouse (France). Div. du Programme Meteosat.
THE METEOSAT OPERATIONAL PROGRAM [LE PROGRAMME OPERATIONALE METEOSAT] c18
P. Louis *In its* ESA Bulletin No. 24 Nov. 1980 p 34-39 In FRENCH (For primary document see N88-16755 09-12)
Copyright Avail: NTIS HC A05/MF A01

Planning and execution of the Meteosat operational program, and Meteosat satellite design are described. Economic profitability and scientific success, particularly in the first GARP global experiment are discussed. Author (ESA)

N88-16760# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Data Handling Div.
EARTHNET'S EXPERIENCE WITH SEASAT SAR IMAGE PROCESSING c32
J. P. Guignard *In its* ESA Bulletin No. 24 Nov. 1980 p 40-45 (For primary document see N88-16755 09-12)
Copyright Avail: NTIS HC A05/MF A01

Synthetic aperture radar (SAR) data transmitted by the Seasat-4 spacecraft was acquired in Europe and processed using optical and digital techniques. Valuable experience was gained at system level with hardware and processing algorithms. Delivery of data was regularly complemented by the organization of workshops aimed at facilitating the dialogue with the potential users of such data, to simulate European user and applications-oriented initiatives. As the different and often unexpected applications of SAR images emerged, optimum extraction of information content become more and more the crucial issue, not just for the Seasat data but more particularly for future SAR-carrying satellite missions, such as a European Earth-resources satellite. Author (ESA)

N88-16761# European Space Agency. ESRIN, Frascati (Italy). Earthnet Program Office.
THE EARTHNET HEAT CAPACITY MAPPING MISSION (HCMM) DATA-PROCESSING SYSTEM AT LANNION (FRANCE) c43
L. Fusco *In its* ESA Bulletin No. 24 Nov. 1980 p 46-52 (For primary document see N88-16755 09-12)
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Within the framework of the Earthnet Program and the Memorandum of Understanding between ESA and NASA, the French Space Meteorology Center is acquiring, archiving, and preprocessing data from NASA's Heat-Capacity Mapping Mission (HCMM) spacecraft. The data from the HCMM support scientific investigations to establish the feasibility of using thermal infrared measurements of the Earth's surface to determine soil thermal inertia. Author (ESA)

N88-16762# European Space Agency, Paris (France).
PROGRAMS UNDER DEVELOPMENT AND OPERATIONS
In its ESA Bulletin No. 24 Nov. 1980 p 53-62 (For primary document see N88-16755 09-12)
Copyright Avail: NTIS HC A05/MF A01

The status of the OTS, Meteosat, EXOSAT, Space Telescope, Spacelab sled, ECS, MARECS, L-Sat, SIRIO 2, remote sensing program, and Spacelab is described. Author (ESA)

N88-16763# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Technical Directorate.
THE NEW APPROACH TO THE DEFINITION OF THE ESA TECHNOLOGICAL RESEARCH PROGRAM
H. Stoewer, J. J. Capart, G. Mica, and G. Whitcomb *In its* ESA Bulletin No. 24 Nov. 1980 p 63-67 (For primary document see N88-16755 09-12)
Copyright Avail: NTIS HC A05/MF A01

After a review in 1979, the approach for updating of the ESA Technological Research Program was reoriented. The need for this reorientation stemmed from the increasing technological complexities of the spacecraft that will be developed in Europe in the 1980s and 1990s and the consequent difficulty in selecting research items to be funded from a limited budget. To assist the choice, a detailed analysis was made of trends in each of the technical disciplines required for the Agency's spacecraft and six major technological themes, subdivided into thirteen projects were derived to serve as a focus for the most important technological research undertakings for the coming decade. Author (ESA)

N88-16764# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Product Assurance Div.
PROMOTION OF EUROPEAN COMPONENTS FOR ESA PROJECTS
U. Emsberger *In its* ESA Bulletin No. 24 Nov. 1980 p 68-71 (For primary document see N88-16755 09-12)
Copyright Avail: NTIS HC A05/MF A01

The ESA procurement policy is outlined, and the reasons for promoting European components are described. Specifications, qualification, and tenders are discussed. Author (ESA)

N88-16765# European Space Agency, Paris (France). Industrial Policy Dept.
EUROPEAN INDUSTRIAL CONSORTIA, FOR SPACE PROJECTS: THEIR ORIGINS, DEVELOPMENT AND POSSIBLE EVOLUTION c31
G. Dondi *In its* ESA Bulletin No. 24 Nov. 1980 p 72-78 (For primary document see N88-16755 09-12)
Copyright Avail: NTIS HC A05/MF A01

The history of consortia formation for European space projects is recalled. The advantages and limitations of consortia are discussed. The industrial structure for European space projects is assessed. Author (ESA)

N88-16766# European Space Agency, Paris (France). Service des Affaires Internationales.
UNISPACE 82
J. Arets *In its* ESA Bulletin No. 24 Nov. 1980 p 79-80 In FRENCH; In FRENCH (For primary document see N88-16755 09-12)
Copyright Avail: NTIS HC A05/MF A01

The preparations for the Unispace 82 conference to discuss how countries without space programs can benefit from space programs are discussed. Author (ESA)

N88-16767# European Space Agency, Paris (France).
ESA BULLETIN NO. 25
Bruce Battrick, ed. and Duc Guyenne, ed. Feb. 1981 86 p (ISSN-0376-4265; ETN-87-90517) Avail: NTIS HC A05/MF A01

The ESA convention; satellite assembly in geostationary orbit; Meteosat photographs of Karman vortex streets in the atmosphere; the Ariane 3 program; solar simulation; satellite power transmission to Earth; parallel processing utilization for remote sensing image processing; and training in satellite ground system operations are discussed. For individual titles, see N88-16768 through N88-16775.

N88-16768# European Space Agency, Paris (France).
ENTRY INTO FORCE OF THE ESA CONVENTION c84
M. Bourely *In its* ESA Bulletin No. 25 Feb. 1981 p 6-9 In ENGLISH and FRENCH (For primary document see N88-16767 09-12)
Avail: NTIS HC A05/MF A01

The organizational and legal consequences of the ESA convention of 30 Oct. 1980 are discussed. Author (ESA)

N88-16769# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Communications Satellite Dept.
SATELLITE ASSEMBLY IN GEOSTATIONARY ORBIT: A PLUG-AND-SOCKET CONCEPT c18
A. W. Preukschat *In its* ESA Bulletin No. 25 Feb. 1981 p 10-15 (For primary document see N88-16767 09-12)
Avail: NTIS HC A05/MF A01

A space-segment construction concept, satellite assembly in geostationary orbit, is described. It can remove mass constraints and appears to have the potential to reduce procurement costs for future communications space segments. A possible configuration has a power-augmented service module (EM) satellite system (the socket) and four payload module (PM) satellites attached (the plugs). The assembly sequence could be launch of the basic SM satellite; launch and docking of three (small) PM satellites, launch and docking of the PFM satellite to augment the system's power capabilities prior to launch and docking of a large, high-power Payload-Module satellite; subsequent launch and attachment of a fourth (small) PM satellite. Author (ESA)

N88-16770# European Space Agency. Centre Spatial de Toulouse (France). Earth Observation Program Office.
METEOSAT TRACKS KARMAN VORTEX STREETS IN THE ATMOSPHERE c46
P. Berlin *In its* ESA Bulletin No. 25 Feb. 1981 p 16-19 (For primary document see N88-16767 09-12)
Avail: NTIS HC A05/MF A01

The vortex street phenomenon is described and Meteosat photographs of vortex streets in the atmosphere are presented. The possibility of vortex streets in the ocean and in the Jupiter atmosphere is considered. Author (ESA)

N88-16771# European Space Agency, Paris (France).
THE ARIANE-3 PROGRAM c15
In its ESA Bulletin No. 25 Feb. 1981 p 21-32 (For primary document see N88-16767 09-12)
Avail: NTIS HC A05/MF A01

The Ariane-3 program is the first phase of an Ariane follow-on development program aimed at increasing the performance and ensuring the competitiveness of the European launcher. The program comprises the development of 2 configurations, Ariane-2 and Ariane-3, with capabilities in transfer orbit of 2000 and 2420 kg respectively, compared with 1700 kg for the initial configuration, Ariane-1. Author (ESA)

N88-16772# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Test Services Div.
DEVELOPMENT OF INFRARED TECHNIQUES FOR TESTING SPACECRAFT c74
J. B. Walker *In its* ESA Bulletin No. 25 Feb. 1981 p 47-52 (For primary document see N88-16767 09-12)
Avail: NTIS HC A05/MF A01

Space/solar simulators are described. Infrared techniques and skin heaters, plate heaters, rod and wire heaters, and tungsten filament quartz lamps are discussed. Instrumentation and power control, and model tests are considered. Author (ESA)

N88-16773# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).
SATELLITE POWER SYSTEMS UNDER CONSIDERATION BY THE UNITED NATIONS c44
D. Kassing *In its* ESA Bulletin No. 25 Feb. 1981 p 53-59 (For primary document see N88-16767 09-12)
Avail: NTIS HC A05/MF A01

It is argued that satellite power systems (SPS) could generate electrical energy on a large scale. There are, however, a number of technical, environmental, and socioeconomic uncertainties that require further study before any decision regarding SPS implementation can be envisaged in the late 1980s or early 1990s. Issues associated with SPS that require international cooperation are addressed. Author (ESA)

N88-16774# European Space Agency. European Space Operations Center, Darmstadt (West Germany). Computer Dept.
PARALLEL-PROCESSING COMPUTER SYSTEMS AND THEIR POSSIBLE APPLICATIONS IN THE AGENCY c62
M. Jones *In its* ESA Bulletin No. 25 Feb. 1981 p 60-65 (For primary document see N88-16767 09-12)
Avail: NTIS HC A05/MF A01

Architectures for parallel-processing computer systems able to cope with the extreme demands of high-speed image processing for remote sensing and for other applications are discussed. Algorithms and languages are considered. Hardware approaches are outlined. Author (ESA)

N88-16775# European Space Agency. European Space Operations Center, Darmstadt (West Germany). Operations Dept.
TRAINING IN SATELLITE GROUND SYSTEM OPERATIONS **c14**
F. W. Stainer and H. P. Dworak *In its* ESA Bulletin No. 25 Feb. 1981 p 66-70 (For primary document see N88-16767 09-12)
Avail: NTIS HC A05/MF A01

The training facilities for gound personnel working on ESA satellite projects are presented. A self study microcomputer course is described. Author (ESA)

N88-16776# European Space Agency, Paris (France). Space Science Dept.
REPORT PRESENTED BY THE EUROPEAN SPACE AGENCY TO THE 22ND COSPAR MEETING
W. R. Burke, ed., D. Jones, ed., R. D. Andresen, F. Beeckmans, A. C. Durney, B. Feuerbacher, K. Knott, F. Macchetto, A. Peacock, and M. Penston (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) et al. May 1979 276 p Meeting held in Bangalore, India, June 1979 Original document contains color illustrations
(ESA-SP-1014; ETN-87-90518) Copyright Avail: NTIS HC A13/MF A01

The status of the HEOS-2, TD-1, ESRO-4, Cos-B, GEOS-1, ISEE, IUE, and GEOS-2 satellites is described. First Spacelab Mission, EXOSAT, International Solar Polar Mission; ESA's participation in the NASA Space Telescope program; the liquid helium cryostat; and Firewheel are discussed. Author (ESA)

N88-16777# European Space Agency, Paris (France).
PROCEEDINGS OF THE ESA WORKSHOP ON CO-ORBITING PLATFORM ELEMENTS (COPE)
T. Duc Guyenne, ed. Sep. 1987 71 p Workshop held in Noordwijk, Netherlands, 7-8 Apr. 1987 Original contains color illustrations
(ESA-SP-1093; ISSN-0379-6566; ETN-88-91413) Copyright Avail: NTIS HC A04/MF A01

Solid Earth, land, ocean, ice, and atmosphere observation from space; spaceborne space science; Columbus Space Station; and microgravity experiments were discussed. For individual titles, see N88-16778 through N88-16784.

N88-16778# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Earth Observation Programs Dept.
AN OVERVIEW OF THE CURRENT EARTH OBSERVATION PROGRAMS (EUROPE, USA, AND JAPAN)
B. R. K. Pfeiffer *In its* Proceedings of the ESA Workshop on Co-Orbiting Platform Elements (COPE) Sep. 1987 p 9-12 Original contains color illustrations (For primary document see N88-16777 09-12)
Copyright Avail: NTIS HC A04/MF A01

The ESA Meteosat, ERS-1, and Earthnet programs are outlined, and their follow-ons and solid Earth and Columbus missions are presented. The NASA Upper Atmosphere Research Satellite, the NASA Scatterometer, the TOPEX/POSEIDON program, shuttle-borne Earth observation payloads, airborne programs, and the implementation of a global Earth observation system are introduced. The NOAA GOES satellites and polar orbiting satellites are discussed. Japanese meteorological and polar orbiting satellites are described. ESA

N88-16779# European Space Agency, Paris (France).
POLAR PLATFORM ELEMENT OF SPACE STATION: MISSION OBJECTIVES, EUROPEAN PRIORITIES, CANDIDATE INSTRUMENTATION AND SELECTION PROCEDURE **c18**
G. Duchossois *In its* Proceedings of the ESA Workshop on Co-Orbiting Platform Elements (COPE) Sep. 1987 p 13-16 (For primary document see N88-16777 09-12)
Copyright Avail: NTIS HC A04/MF A01

Use of Space Station platforms for observation of the atmosphere, oceans and ice, land processes, and solid Earth is discussed. It is stressed that the European program must be complementary to existing Earth observation programs developed within Europe and by other countries. Technological requirements enable European industry to enhance competitivity in antennas, lasers, high speed electronics, optics, etc. Highest mission priorities are continuous monitoring of atmospheric, oceanic, and ice processes at global scale, and continuous monitoring of land processes and resources. Core instruments include active and passive microwave sensors, optical sensors, atmospheric sounder, and limb sounder. ESA

N88-16780# European Space Agency, Paris (France). Space Station and Platforms Directorate.
SPACE STATION OVERVIEW **c18**
G. P. Haskell *In its* Proceedings of the ESA Workshop on Co-Orbiting Platform Elements (COPE) Sep. 1987 p 17-20 Original contains color illustrations (For primary document see N88-16777 09-12)
Copyright Avail: NTIS HC A04/MF A01

The Core Space Station and the Columbus, man tended free flyer, co-orbiting platform, attached payloads, and Japanese Experiment Module are illustrated. Columbus is mainly devoted to fluid sciences, life sciences, and material sciences, but Earth observation is possible. Free flyers are intended for activities requiring uninterrupted and high quality microgravity exposure. The Japanese module is designed for general scientific and technological studies. ESA

N88-16781# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Systems Engineering Dept.
TETHERS: AN OUTLINE OF A NEW CONCEPT FOR EARTH OBSERVATION **c18**
C. A. Markland *In its* Proceedings of the ESA Workshop on Co-Orbiting Platform Elements (COPE) Sep. 1987 p 21-23 (For primary document see N88-16777 09-12)
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The tethered satellite concept is introduced, and the advantages of being able to fly sensors closer to the Earth's surface than is normally possible with spacecraft (e.g., 200 to 100 km altitude) are underlined. Tethers can also be used to fly several sensors with well defined separation. Problems arise in dynamics and control, and the tether can be damaged by heating or space debris. Columbus platforms could carry tethers. Earth observation missions, including high resolution remote sensing, gravity gradiometry, geomagnetic surveys, and atmospheric sounding are suggested. ESA

N88-16782# European Space Agency, Paris (France). Scientific Program Directorate.
USE OF SPACE STATION FOR SPACE SCIENCE **c89**
G. P. Haskell *In its* Proceedings of the ESA Workshop on Co-Orbiting Platform Elements (COPE) Sep. 1987 p 25-26 (For primary document see N88-16777 09-12)
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Space Station cornerstone and other space science missions are outlined. The cornerstone missions are the comet nucleus sample return mission and the submillimeter heterodyne spectroscopy mission. Gamma ray spectroscopy, cosmic ray background anisotropy measurements, astroseismology, and stellar activity studies are suggested. The particulate content of near Earth space can be monitored and evaluated. Solar-terrestrial physics investigations are possible. The EURECA platform can be used for space science, in spite of its essentially microgravity payload orientation. ESA

N88-16783# European Space Agency, Paris (France). Microgravity Office.
MICROGRAVITY PAYLOADS AND MISSIONS FOR SPACE STATION: SOME ISSUES AFFECTING COMPATIBILITY WITH OTHER PAYLOADS **c29**
P. Clancy *In its* Proceedings of the ESA Workshop on Co-Orbiting Platform Elements (COPE) Sep. 1987 p 27-28 (For primary

document see N88-16777 09-12)
Copyright Avail: NTIS HC A04/MF A01

Conflicts between Earth observation and space science and microgravity payloads on the Space Station are discussed. Earth observation and space science instruments, in order to be compatible with microgravity payloads, have to operate in such a way as to minimize disturbances transmitted to the carrier by pointing, scanning, and similar maneuvers. Microgravity payloads such as material science furnaces are likely (due to venting of volatile materials and gases) to produce considerable pollution of the external space environment near the spacecraft. This is likely to be a problem for optical instruments used for Earth observation or astronomy especially if cooled optical surfaces are involved where these materials could condense on and obscure the optics. Other conflicts involve competition for data channels, thermal compatibility, and competition for power. ESA

N88-16784# European Space Agency, Paris (France). Space Station and Platforms Directorate.
THE COLUMBUS PROGRAM, AN OVERVIEW
D. J. Shapland *In its* Proceedings of the ESA Workshop on Co-Orbiting Platform Elements (COPE) Sep. 1987 p 61-67 Also presented at the ESOIR Workshop, Avignon, France, Jun. 1986 (For primary document see N88-16777 09-12)
Copyright Avail: NTIS HC A04/MF A01

Columbus program candidate elements are described. The elements are a pressurized module/laboratory permanently attached to the Space Station core; a man-tended free flyer (pressurized module plus resource module); a polar platform; and a co-orbiting platform, based on EURECA. A scenario and schedule of events is discussed in the framework of a total European plan. The importance of user requirements is stressed and the handling of those needs is discussed. ESA

13 ASTRODYNAMICS

Includes powered and free-flight trajectories; and orbital and launching dynamics.

No abstracts in this category.

14 GROUND SUPPORT SYSTEMS AND FACILITIES (SPACE)

Includes launch complexes, research and production facilities; ground support equipment, e.g., mobile transporters; and simulators.

For related information see also *09 Research and Support Facilities (Air).*

N88-16785# Aeronautical Research Labs., Melbourne (Australia).
EXPERIMENTAL INVESTIGATION OF A THREE-STAGE RAILGUN INCORPORATING PUFF-SWITCHING
D. R. Sadedin and D. F. Stainsby May 1987 74 p
(MRL-R-1056; AR-005-135) Avail: NTIS HC A04/MF A01

A sequence of four firings of a 2.4 m long, 10 mm square bore railgun is described and analyzed. The railgun comprised an injection stage, a breech power source and a second power source which was connected by a puff-switch. The report deals with the puff-switching results, distribution of current in the plasma, the proportion of the projectile kinetic energy due to plasma expansion forces as compared to electromagnetic forces, the correlation of rail damage with current and plasma length, and velocity limitation according to the ablation model. Author

N88-16786# Aeronautical Research Labs., Melbourne (Australia).
THE RAILGUN AND ITS POWER SOURCE
D. R. Sadedin and W. J. Bonwick (Monash Univ., Clayton, Australia) Jun. 1987 355 p
(MRL-R-1058; AR-005-133) Avail: NTIS HC A16/MF A01

Investigations into the propulsion mechanisms of railguns and into the power source requirements of railguns are reported. Power sources based on rotating machines, capacitors and explosives are reviewed and a new method based on batteries and pulse transformers is identified. The battery and pulse transformer method is studied in detail. Author

N88-16726# European Space Agency, Paris (France). Directorate of Planning and Future Programs.
COORDINATED USE OF EUROPEAN TEST FACILITIES
R. Broezel *In its* ESA Bulletin No. 8 Feb. 1977 p 54-57 (For primary document see N88-16718 09-12)
Avail: NTIS HC A05/MF A01

N88-16746# European Space Agency, Paris (France). Ariane Dept.
THE ARIANE LAUNCH BASE
C. Dana and A. Bellot *In its* ESA Bulletin No. 15: Ariane, the European Launcher for the 1980's Aug. 1978 p 30-36 (For primary document see N88-16741 09-12)
Copyright Avail: NTIS HC A05/MF A01

N88-16747# Societe Europeenne de Propulsion, Vernon (France).
ALTITUDE SIMULATION TESTING OF ARIANE'S SECOND-STAGE ENGINE
G. Dorville, H. Holsten, and G. Tofahrn (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Hardthausen, West Germany) *In* ESA, ESA Bulletin No. 15: Ariane, the European Launcher for the 1980's Aug. 1978 p 37-40 (For primary document see N88-16741 09-12)
Copyright Avail: NTIS HC A05/MF A01

N88-16775# European Space Agency. European Space Operations Center, Darmstadt (West Germany). Operations Dept.
TRAINING IN SATELLITE GROUND SYSTEM OPERATIONS
F. W. Stainer and H. P. Dworak *In its* ESA Bulletin No. 25 Feb. 1981 p 66-70 (For primary document see N88-16767 09-12)
Avail: NTIS HC A05/MF A01

N88-17209*# Computer Sciences Corp., Houston, Tex. Applied Technology Div.
MPAD MCC WORKSTATION SYSTEM: ADDAM AND EEVE
Bill Kozick, Jr. and Walt Reynolds *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 15-24 (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 14B

N88-17214*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
AN INTELLIGENT TRAINING SYSTEM FOR PAYLOAD-ASSIST MODULE DEPLOYS
R. Bowen Loftin (Houston Univ., Tex.), Lui Wang, Paul Baffes, and Monica Rua *In its* First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 53-59 (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 14B

N88-17215*# Air Force Human Resources Lab., Wright-Patterson AFB, Ohio. Manpower and Personnel Div.
TUTORING ELECTRONIC TROUBLESHOOTING IN A SIMULATED MAINTENANCE WORK ENVIRONMENT
Sherrie P. Gott *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 61-69

(For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 14B

N88-17216*# Air Force Human Resources Lab., Brooks AFB, Tex.
INTELLIGENT TUTORING SYSTEMS AS TOOLS FOR INVESTIGATING INDIVIDUAL DIFFERENCES IN LEARNING
Valerie J. Shute *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 71-75 (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 14B

N88-17217*# North Texas State Univ., Denton. Dept. of Computer Sciences.
AN INTELLIGENT TUTOR FOR THE SPACE DOMAIN
Kathleen Swigger and Harry Loveland *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 77-83 Sponsored in part by AF (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 14B

N88-17221*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
DESIGN OF A NEURAL NETWORK SIMULATOR ON A TRANSPUTER ARRAY
Gary McIntire (Ford Aerospace and Communications Corp., Houston, Tex.), James Villarreal, Paul Baffes, and Monica Rua *In its* First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 111-118 (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 09C

N88-17224*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
USER INTERFACE DEVICES FOR MISSION CONTROL
Wayne Boatman *In its* First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 133-134 (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 14B

N88-17271*# Central Inertial Guidance Test Facility, Holloman AFB, N.Mex.
DEVELOPMENT OF A FACILITY USING ROBOTICS FOR TESTING AUTOMATION OF INERTIAL INSTRUMENTS
Joy Y. Greig, Gary B. Lamont, Daniel J. Biezad, and Zdsislaw H. Lewantowicz (Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.) *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 477-483 (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 14B

15 LAUNCH VEHICLES AND SPACE VEHICLES

Includes boosters; operating problems of launch/space vehicle systems; and reusable vehicles.

For related information see also *20 Spacecraft Propulsion and Power.*

N88-16787# Ballistic Research Labs., Aberdeen Proving Ground, Md.
A COMPARISON BETWEEN THEORY AND EXPERIMENT FOR THE YAW MOMENT INDUCED BY A LOOSE INTERNAL PART Final Report
William P. DAmico, Jr. Dec. 1986 99 p Supersedes IMR-825 (DA Proj. 1L1-62618-AH-80)
(AD-A187053; BRL-MR-3577; IMR-825) Avail: NTIS HC A05/MF A01 CSCL 19A

Spin stabilized projectiles often employ internal parts that are loose. Typical examples are safety mechanisms within fuzes, payload components, or submunitions. A series of tests were conducted where a loose internal part was driven by the rotor of a freely gimballed gyroscope. The motion of the loose part is not identical to that of the gyroscope and will cause the gyroscope yaw to grow. The gyroscope yaw history and the orbital motion of the loose part were measured to determine the phase angle between the motion of the loose part and the yawing motion of the gyroscope. The experimental data were used as input parameters to a theory that predicts moments (and, therefore, the yaw growth rate) induced by a loose internal part. Where the assumptions of the theory were appropriately modeled by the experiment, comparisons of theoretical and experimental yaw growth rates were consistent. GRA

N88-16727# Centre National d'Etudes Spatiales, Paris (France). Ariane Project Team.
LAUNCH VEHICLE VIBRATION: MEASURES TAKEN TO AVOID POGO ON ESA'S ARIANE LAUNCH VEHICLE
Ph. Couillard and W. G. Naumann *In its* ESA Bulletin No. 8 Feb. 1977 p 58-60 (For primary document see N88-16718 09-12)
Avail: NTIS HC A05/MF A01

N88-16742# Centre National d'Etudes Spatiales, Paris (France). Ariane Project Team.
THE ARIANE LAUNCHER AND ITS PROGRESS
R. Vignelles and P. Rasse *In* ESA, ESA Bulletin No. 15: Ariane, the European Launcher for the 1980's Aug. 1978 p 10-21 In ENGLISH and FRENCH (For primary document see N88-16741 09-12)
Copyright Avail: NTIS HC A05/MF A01

N88-16743# Centre National d'Etudes Spatiales, Paris (France). Forward Planning Div.
ARIANE LAUNCH PERFORMANCE
M. Gilli *In* ESA, ESA Bulletin No. 15: Ariane, the European Launcher for the 1980's Aug. 1978 p 22-25 In ENGLISH and FRENCH (For primary document see N88-16741 09-12)
Copyright Avail: NTIS HC A05/MF A01

N88-16744# European Space Agency, Paris (France). Ariane Dept.
INCREASED PERFORMANCE FOR ARIANE
A. Lemarchand *In its* ESA Bulletin No. 15: Ariane, the European Launcher for the 1980's Aug. 1978 p 26-29 (For primary document see N88-16741 09-12)
Copyright Avail: NTIS HC A05/MF A01

N88-16745# European Space Agency, Paris (France). Ariane Dept.
SYLDA: A DUAL-LAUNCH SYSTEM FOR ARIANE
W. Naumann *In its* ESA Bulletin No. 15: Ariane, the European Launcher for the 1980's Aug. 1978 p 28-19 (For primary document see N88-16741 09-12)
Copyright Avail: NTIS HC A05/MF A01

N88-16748# Centre National d'Etudes Spatiales, Paris (France). Ariane Project Team.
MECHANICAL IN-FLIGHT ENVIRONMENT OF ARIANE PAYLOADS
M. Vedrenne *In* ESA, ESA Bulletin No. 15: Ariane, the European Launcher for the 1980's Aug. 1978 p 41-43 (For primary document see N88-16741 09-12)
Copyright Avail: NTIS HC A05/MF A01

N88-16749# Societe Nationale Industrielle Aerospatiale, Les Mureaux (France).
DYNAMIC TESTS OF THE ARIANE LAUNCH VEHICLE [ESSAIS DYNAMIQUES D'ENSEMBLE DU VEHICULE ARIANE]
M. Claramonte *In* ESA, ESA Bulletin No. 15: Ariane, the European Launcher for the 1980's Aug. 1978 p 44-50 In FRENCH

(For primary document see N88-16741 09-12)
Copyright Avail: NTIS HC A05/MF A01

N88-16752# Centre National d'Etudes Spatiales, Paris (France). Ariane Project Team.
STAGE SEPARATION TESTING OF ARIANE
P. Gauge *In* ESA, ESA Bulletin No. 15: Ariane, the European Launcher for the 1980's Aug. 1978 p 67-70 (For primary document see N88-16741 09-12)
Copyright Avail: NTIS HC A05/MF A01

N88-16754# Centre National d'Etudes Spatiales, Paris (France). Ariane Project Team.
THE ARIANE FAIRING AND ITS SEPARATION SYSTEMS
R. W. Jaeger *In* ESA, ESA Bulletin No. 15: Ariane, the European Launcher for the 1980's Aug. 1978 p 78-83 (For primary document see N88-16741 09-12)
Copyright Avail: NTIS HC A05/MF A01

N88-16771# European Space Agency, Paris (France).
THE ARIANE-3 PROGRAM
In its ESA Bulletin No. 25 Feb. 1981 p 21-32 (For primary document see N88-16767 09-12)
Avail: NTIS HC A05/MF A01

16 SPACE TRANSPORTATION

Includes passenger and cargo space transportation, e.g., shuttle operations; and space rescue techniques.

For related information see also *03 Air Transportation and Safety* and *18 Spacecraft Design, Testing and Performance*. For space suits see *54 Man/System Technology and Life Support*.

N88-16788*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
LATERAL STABILITY AND CONTROL DERIVATIVES EXTRACTED FROM SPACE SHUTTLE CHALLENGER FLIGHT DATA
James R. Schiess Jan. 1988 33 p
(NASA-TM-100520; NAS 1.15:100520) Avail: NTIS HC A03/MF A01 CSCL 22B

Flight data taken from six flights of the Space Transportation System shuttle Challenger (STS-6, 7, 8, 11, 13 and 17) during atmospheric entry are analyzed to determine the shuttle lateral aerodynamic characteristics. Maximum likelihood estimation is applied to data derived from accelerometer and rate gyro measurements and trajectory, meteorological and control surface data to estimate lateral-directional stability and control derivatives. The vehicle stability and control surface effectiveness are compared across the flights and to preflight predicted values. Author

N88-16723# European Space Agency, Porz-Wahn (West Germany).
ASSESS-2: AN AIRCRAFT SIMULATION OF SPACELAB
J. Dewaard and D. J. Shapland (European Space Agency, Paris, France) *In its* ESA Bulletin No. 8 Feb. 1977 p 24-28 (For primary document see N88-16718 09-12)
Avail: NTIS HC A05/MF A01

N88-17208*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
SPACE SHUTTLE ONBOARD NAVIGATION CONSOLE EXPERT/TRAINER SYSTEM
Lui Wang and Dan Bochsler (LinCom Corp., Houston, Tex.) *In its* First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 11-14 (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 22B

N88-17237*# IBM Federal Systems Div., Houston, Texas.
VERIFYING SHUTTLE ONBOARD SOFTWARE USING EXPERT SYSTEMS
William B. Wingert *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 223-225 (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 22B

N88-17244*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
AUTONOMOUS CONTROL PROCEDURES FOR SHUTTLE RENDEZVOUS PROXIMITY OPERATIONS
Robert N. Lea, Eric V. Mitchell, and Mary Ann Goodwin (Rockwell Shuttle Operations Co., Houston, Tex.) *In its* First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 281-286 (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 22B

N88-17247*# National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.
EXPERT MISSION PLANNING AND REPLANNING SCHEDULING SYSTEM FOR NASA KSC PAYLOAD OPERATIONS
Roger Pierce *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 299-306 (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 22B

17 SPACE COMM., SPACECRAFT COMM., COMMAND & TRACKING

Includes telemetry; space communications networks; astronavigation and guidance; and radio blackout.

For related information see also *04 Aircraft Communications and Navigation* and *32 Communications and Radar*.

N88-16789# Pacific Missile Test Center, Point Mugu, Calif. Weapons Instrumentation Div.
TELEMETRY APPLICATIONS HANDBOOK
Eugene L. Law and Donald R. Hust Sep. 1987 349 p
(AD-A186825; PMTC-TP-000044) Avail: NTIS HC A15/MF A01 CSCL 09F

The purpose of this handbook is to provide practical information about telemetry system engineering. This handbook is intended to be useful to both system designers and operators. This handbook is divided into five sections: (1) Introduction; (2) Telemetry terminology; (3) Telemetry signals and noise; (4) Telemetry transmitting system characterization; and (5) Telemetry receiving system characterization. The subjects discussed include: (1) Parameter optimization for best data quality; (2) Radio frequency spectral occupancy; (3) Relationship of theory to real-world telemetry problems. GRA

N88-16790# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Data Handling and Signal Processing Div.
PCM TELEMETRY STANDARD
Apr. 1978 44 p
(ESA-PSS-46(TTC.A.02)ISS-1; ETN-87-90503) Copyright Avail: NTIS HC A03/MF A01

A set of uniform techniques that permit reliable and efficient transmission of analog and/or digital data from ESA spacecraft are specified. It is possible to guarantee optimum performance during data-recovery operations in the ESA ground stations. The level of compatibility with the equivalent NASA-OSFC Telemetry Standards is also indicated. Author (ESA)

N88-16791# European Space Agency, Paris (France).
THE NAVIGATION EXPERMENT NAVEX: EXPERIMENTAL RESULTS OF CLOCK SYNCHRONIZATION
Emil Sappl and Anita Zimmermann Oct. 1987 28 p Transl. into ENGLISH of Navigationsexperiment NAVEX Messergebnisse zum Zeitvergleich (DFVLR, Oberpfaffenhofen, Fed. Republic of

Germany), Jan. 1987 Original language document was announced as N88-11701
(ESA-TT-1084; DFVLR-Mitt-87-05; ETN-88-91335) Avail: NTIS HC A03/MF A01; original German version available from DFVLR, Cologne, Fed. Republic of Germany DM 12.50

Experimental results, gathered on Spacelab during the D1 mission are presented. The results were used to compare onboard time and time at the control station. The measuring values and their processing are explained. The processed measuring data are listed. The significance of the measurement results for the clock synchronization is discussed. ESA

18 SPACECRAFT DESIGN, TESTING AND PERFORMANCE

Includes satellites; space platforms; space stations; spacecraft systems and components such as thermal and environmental controls; and attitude controls.

For life support systems see *54 Man/System Technology and Life Support.* For related information see also *05 Aircraft Design, Testing and Performance, 39 Structural Mechanics,* and *16 Space Transportation.*

N88-16792* Rockwell International Corp., Downey, Calif. Space Station Systems Div.
SPACE STATION STRUCTURES DEVELOPMENT
V. B. Teller Oct. 1986 332 p
(Contract NAS8-36421)
(NASA-CR-179261; NAS 1.26:179261; SSS-86-0133) Avail: NTIS HC A15 CSCL 22B

A study of three interrelated tasks focusing on deployable Space Station truss structures is discussed. Task 1, the development of an alternate deployment system for linear truss, resulted in the preliminary design of an in-space reloadable linear motor deployer. Task 2, advanced composites deployable truss development, resulted in the testing and evaluation of composite materials for struts used in a deployable linear truss. Task 3, assembly of structures in space/erectable structures, resulted in the preliminary design of Space Station pressurized module support structures. An independent, redundant support system was developed for the common United States modules. Author

N88-16793# Naval Postgraduate School, Monterey, Calif.
VERIFICATION OF A MICRO-THRUSTING MODEL TO MAINTAIN SATELLITES IN LOW ORBIT M.S. Thesis
Christopher D. Noble Jun. 1987 168 p
(AD-A186874) Avail: NTIS HC A08/MF A01 CSCL 22C

New concepts in aerospace travel have renewed interest in modeling and compensating for the effects of upper atmospheric drag. In particular, the Strategic Defense Initiative (SDI) constellation requires strict orbital element maintenance. This thesis is a qualitative verification of a propellant longevity model for low-altitude earth orbit satellites verification of a propellant longevity model for low altitude earth orbit satellites doing intrack micro-thrusting to overcome atmospheric drag. Pertinent orbital mechanics and atmospheric concepts are reviewed. The model and its computer program are described. The results of trend and sensitivity analysis reasonableness tests are presented. Finally suggestions for use are made. Many plots of mission life predictions are presented. The model computer program and sample input and output are also included. GRA

N88-16794*# Ford Aerospace and Communications Corp., Palo Alto, Calif. Space Systems Div.
COMMUNICATIONS SATELLITE SYSTEMS OPERATIONS WITH THE SPACE STATION. VOLUME 3: SUPPLEMENTARY TECHNICAL REPORT Final Report, Feb. - Dec. 1987
K. M. Price, P. Russell, and C. Weyandt Feb. 1988 221 p
(Contract NAS3-24253)
(NASA-CR-180875; NAS 1.26:180875) Avail: NTIS HC A10/MF A01 CSCL 22B

The NASA space station has the potential to provide significant economic benefits to commercial communications satellite operators. The initial reports qunatified the benefits of space-based activities and assessed the impacts on the satellite design and the space station. Results are given for the following additional tasks: quantify the value of satellite retrievability operations and define its operational aspects; evaluate the use of expendable launch vehicles for transportation of satellites from the Earth to the space station; and quantify the economic value of modular satellites that are assembled and serviced in space. Author

N88-16795# British Aerospace Dynamics Group, Stevenage (England). Space and Communications Div.
FINE ATTITUDE MEASUREMENT SYSTEM STUDY. VOLUME 1: EXECUTIVE SUMMARY Final Report
M. Burton, comp. Paris, France ESA Oct. 1980 36 p Prepared in cooperation with Matra Espace, Paris-Velizy, France
(Contract ESA-4230/80-NL-PP(SC))
(BAe-TP-7831-Vol-1; ESA-CR(P)-1436-Vol-1; ETN-87-90508)
Copyright Avail: NTIS HC A03/MF A01

The definition of a fine attitude measurement system was analyzed using data from the TPD/TNO star mapper, the SODERN star tracker, and the MEDS star mapper, for Earth resources missions. Configurations, preliminary interface data, and performances were generated. Performance was treated parametrically to account for the early definition of the star sensors and other system parameters (alignment, orbit determination). The study should be refined by re-examining the issues after the star sensor definition studies are completed. Author (ESA)

N88-16796# British Aerospace Dynamics Group, Stevenage (England). Space and Communications Div.
FINE ATTITUDE MEASUREMENT SYSTEM STUDY, VOLUME 2 Final Report
Paris, France ESA Oct. 1980 163 p Prepared in cooperation with Matra Espace, Paris-Velizy, France
(Contract ESTEC-4230/80-NL-PP(SC))
(BAe-TP-7831-VoL-2; ESA-CR(P)-1436-Vol-2; ETN-87-90509)
Copyright Avail: NTIS HC A08/MF A01

The definition of a fine attitude measurement system was analyzed using data from the TPD/TNO star mapper, the SODERN star tracker, and the MSDS star mapper, for Earth resources missions. Configurations, preliminary interface data, and performances were generated. Performance was treated parametrically to account for the early definition of the star sensors and other system parameters (alignment, orbit determination). The study should be refined by re-examining the issues after the star sensor definition studies are completed. Author (ESA)

N88-16797# British Aerospace Dynamics Group, Stevenage (England). Space and Communication Div.
FINE ATTITUDE MEASUREMENT SYSTEM STUDY. VOLUME 3: APPENDICES Final Report
Paris, France ESA Oct. 1980 80 p Prepared in cooperation with Matra Espace, Paris-Velizy, France
(ESTEC-4230/80-NL-PP(SC))
(BAe-TP-7831-Vol-3; ESA-CR(P)-1436-Vol-3; ETN-87-90510)
Copyright Avail: NTIS HC A05/MF A01

The definition of a fine attitude measurement system was analyzed using a data from the TPD/TNO star mapper, the SODERN star tracker, and the MSDS star mapper, for Earth resources missions. Comparison of a star tracker with and without gyroscopes; mathematical models; onboard estimation of gyro drift and applications to precision attitude control; and software evaluation of Kalman filter are summarized. ESA

N88-16798# Sener, S.A., Madrid (Spain).
COORBITING PLATFORM UTILIZATION STUDY (CPLUS), EXECUTIVE SUMMARY
A. Aldamiz Paris, France ESA 15 Jul. 1987 44 p
(SN-WP-4000-Doc-6609/85/F; ESA-CR(P)-2461; ETN-88-91416)
Copyright Avail: NTIS HC A03/MF A01

Accommodation for ESA payloads on the main truss structure of the space station was studied. It is concluded that the truss structure is suitable for the accommodation of attached payloads. European opportunity is very sensitive to American decisions and other user nation competition. Payload grouping on dedicated ESA carriers is the best way for an optimum usage of attachment points. The most promising attachment location on the truss structure is on the upper beam. The mission baseline schedule is too long due to European constraints. Items of flight and in-orbit resources demand the biggest funding effort (44 percent and 28 percent respectively). Man tended free flyers are suitable for small payloads. ESA

N88-16799# Messerschmitt-Boelkow-Blohm G.m.b.H., Bremen (West Germany).
COLUMBUS FEASIBILITY STUDIES. VOLUME 1: REQUIREMENTS AND SYSTEM CONCEPT Final Report
1986 506 p Sponsored by Bundesministerium fuer Forschung und Technologie/DFVLR and the PCB/MRST Prepared in cooperation with Aeritalia SpA, Turin, Italy and Dornier-Werke GmbH, Friedrichshafen, West Germany
(ETN-88-91073) Avail: NTIS HC A22/MF A01

The Columbus Space Station scenario, payload requirements, general system requirements, and design objectives are outlined. The system concept is described. The requirements are primarily driven by the interfacing system, i.e., the Manned Space Station (MSS), the Shuttle Space Transport System (STS) and the prospective payloads. Further requirements result from the inherent needs of the Columbus system itself, and from technical and operational constraints. The Columbus concept, in its initial phases, depends on U.S. resources like STS, MSS, and TDRS, but it is also adaptable to a potential future European space station with elements which are not yet in the Columbus scenario. This applies to the principal concepts of the elements and to the development of subsystem hardware and software. It is shown that the system concept meets design requirements. ESA

N88-16800# Messerschmitt-Boelkow-Blohm G.m.b.H., Bremen (West Germany).
COLUMBUS FEASIBILITY STUDIES. VOLUME 2: ELEMENT CONSTITUENTS, MECHANICAL Final Report
1986 351 p Sponsored by Bundesministerium fuer Forschung und Technologie/DFVLR and the PCN/MRST Prepared in cooperation with Aeritalia SpA, Turin, Italy and Dornier-Werke GmbH, Friedrichshafen, West Germany
(ETN-88-91074) Avail: NTIS HC A16/MF A01

The Columbus Space Station pressurized module, payload carrier, resource module, and servicing vehicle subsystem requirements are outlined. The structural, thermal control, life support and environmental, and mechanisms and robotics subsystems are discussed. ESA

N88-16801# Messerschmitt-Boelkow-Blohm G.m.b.H., Bremen (West Germany).
COLUMBUS FEASIBILITY STUDIES. VOLUME 3: AVIONICS, SYSTEMS Final Report
1986 453 p Sponsored by Bundesministerium fuer Forschung und Technologie/DFVLR and the PCN/MRST Prepared in cooperation with Aeritalia SpA, Turin, Italy and Dornier-Werke GmbH, Friedrichshafen, West Germany
(ETN-88-91075) Avail: NTIS HC A20/MF A01

The Columbus information management, electrical power supply and distribution, telecommunication, guidance and navigation, attitude control, propulsion; and rendezvous and docking systems are discussed. ESA

N88-16802# Messerschmitt-Boelkow-Blohm G.m.b.H., Bremen (West Germany).
COLUMBUS FEASIBILITY STUDIES. VOLUME 5: PROGRAMMATICS Final Report
1986 154 p Sponsored by Bundesministerium fuer Forschung und Technologie/DFVLR and the PCN/MRST Prepared in cooperation with Aeritalia SpA, Turin, Italy and Dornier-Werke GmbH, Friedrichshafen, West Germany
(ETN-88-91076) Avail: NTIS HC A08/MF A01

The Columbus Space Station program planning and cost estimates, development plan/philosophy, and specifications are discussed. ESA

N88-16803# Consulenze Generali Roma (Italy).
ANALYTICAL INTERACTIVE APPROACH FOR PHENOMENA INVOLVING STRUCTURES, THERMAL AND CONTROL ASPECTS. VOLUME 1: THEORY Final Report
C. Arduini, G. Fusco, and S. Sgubini Paris, France ESA Dec. 1985 347 p
(Contract ESTEC-5485/83-NL-PB(SC))
(ESA-CR(P)-2503-Vol-1; ETN-88-91205) Avail: NTIS HC A15/MF A01

The problem of producing comprehensive equations for describing the thermostructural fully interactive behavior of uni- and bi-dimensional elements (like beams, plates, shells) was studied. Ways of assembling these elements together, and with mechanical and thermal control devices were investigated. Conduction theory; radiative inputs (the shadow problem); elastic, inertial, and thermal loads; and interface constraints and assembly of elements are discussed. ESA

N88-16804# Consulenze Generali Roma (Italy).
ANALYTICAL INTERACTIVE APPROACH FOR PHENOMENA INVOLVING STRUCTURES, THERMAL, AND CONTROL ASPECTS. VOLUME 2: TOWARD THE SOLUTION Final Report
C. Arduini, G. Fusco, and S. Sgubini Paris, France ESA Dec. 1985 266 p
(Contract ESTEC-5485/83-NL-PB(SC))
(ESA-CR(P)-2503-Vol-2; ETN-88-91206) Avail: NTIS HC A12/MF A01

The problem of producing comprehensive equations for describing the thermostructural fully interactive behavior of uni and bidimensional elements (like beams, plates, shells) was studied. Ways of assembling these elements together, and with mechanical and thermal control devices were investigated. Methods for problems in the space domain of interactive problems are outlined. Examples of heat inputs and shadows; thermal problems; thermoelastic problems; and structure control interaction are shown. ESA

N88-16805# Consulenze Generali Roma (Italy).
ANALYTICAL INTERACTIVE APPROACH FOR PHENOMENA INVOLVING STRUCTURES, THERMAL, AND CONTROL ASPECTS. VOLUME 3: EXECUTIVE SUMMARY Final Report
C. Arduini, G. Fusco, and S. Sgubini Paris, France ESA Dec. 1985 67 p
(Contract ESTEC-5485/83-NL-PB(SC))
(ESA-CR(P)-2503-Vol-3; ETN-88-91211) Avail: NTIS HC A04/MF A01

The problem of producing comprehensive equations for describing the thermostructural fully interactive behavior of uni and bidimensional elements (like beams, plates, shells) was studied. Ways of assembling these elements together, and with mechanical and thermal control devices were investigated. ESA

N88-16806# Fokker B.V., Amsterdam (Netherlands).
OPTIMIZED APPROACH TO DAMAGE TOLERANCE Final Report
J. Ph. vanHerwaarden and A. U. deKoning (National Aerospace Lab., Amsterdam, Netherlands) May 1987 279 p
(Contract ESA-5826/84-NL-PB(SC))
(FOK-FSS-R-87-024; ESA-CR(P)-2505; NLR-TR-86123-L; ETN-88-91298) Copyright Avail: NTIS HC A13/MF A01

Work necessary to perform damage tolerance control, i.e., load spectra prediction methods; crack growth prediction methods; evaluation of flight data (STS); comparison of prediction methods against flight data and material data; and operational implementation of prediction methods is summarized. A computer coding called ESACRACK, including the modules ESALOAD and NASGRO is described. The ESALOAD generates a stress

spectrum, which is directly usable in NASGRO, which performs crack growth predictions. ESA

N88-16807# Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).
MULTISURFACE CONTROL MECHANISM FOR A DEPLOYABLE ANTENNA: FAR INFRARED AND SUBMILLIMETER SPACE TELESCOPE (FIRST) TECHNOLOGY STUDY Final Report
Paris, France ESA Jan. 1987 113 p Prepared in cooperation with Sener SA, Madrid (Spain)
(Contract ESTEC-5994/84-NL-AN(SC))
(RP-FA-D003; ESA-CR(P)-2506; ETN-88-91300) Avail: NTIS HC A06/MF A01

Antenna control for the Far Infrared and Submillimeter Space Telescope 8 m, foldable dish was investigated. The best fit contour of the reflector must not deviate from the ideal paraboloid by greater than 8 microns rms throughout the operational temperature range between minus 107 and minus 185 C. The structural design leads to CFRP sandwich shell elements on self supporting CFRP frameworks. Aluminum and Kevlar cores were studied as to their effects on thermally induced contour errors, and an error budget was established. Mechanisms for fixing the stowed and unfolded configuration and for panel deployment were defined. Methods for in-orbit calibration were identified and an on-ground adjustment concept for antenna assembly was defined. A panel with CFRP cover sheets and an Al core was exposed to a thermal cycling test, proving manufacturing accuracy and insensitivity to thermal loads. The suitability of the surface coating is demonstrated by microwave reflectivity measurements. Breadboard models of adjustment mechanisms for in-orbit correction of the main dish contour were successfully tested. ESA

N88-16808# Alcatel Thomson Espace, Courbevoie (France).
STUDY OF RECONFIGURABLE PAYLOADS FOR DIRECT BROADCAST SATELLITES, SUMMARY
R. Gutierrez Paris, France ESA 8 Apr. 1987 32 p Prepared in cooperation with SNIAS, Paris, France, and ANT Nachrichtentechnik, Backnang, West Germany
(Contract ESTEC-6397-85-NL-DG)
(DBS87-0004; ESA-CR(P)-2492; ETN-88-91703) Copyright Avail: NTIS HC A03/MF A01

An overall satellite broadcast system using reconfigurable payloads for national direct broadcast satellite (DBS) applications was analyzed. Reconfigurable DBS used as common spares by Germany, France, and Italy was studied. The possibility of only Germany and France using the common spares is also considered. Service availability and costs for the overall satellite broadcasting system were investigated. The reconfigurable payload schemes and equipment performances are assessed. A comparison with systems using only national satellites shows that for a given service availability, a significant number of satellites can be saved by using reconfigurable DBS. Key payload equipment (an in-orbit tunable output multiplexer and a reconfigurable multifeed antenna) are examined. ESA

N88-16809# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany).
MODEL OF SPACE PLATFORM ELECTROMAGNETIC (EMC) CONFIGURATION Final Report
Paris, France ESA 30 Jun. 1987 114 p
(Contract ESA-6536/85-NL-MA(SC))
(ESA-CR(P)-2500; ETN-88-91705) Avail: NTIS HC A06/MF A01

The ESAESA tool containing an electromagnetic compatibility (EMC) data base, EMC prediction programs, EMC management data, and descriptive data (e.g., test set-ups) was developed, based on the Test Data Analysis System (TDAS), for EMC analysis of Columbus. The goals of ESAESA include improved project economics, harmonization, complete coverage of EMC work, improvement of tests and prediction data quality, and the ability to handle problems related to in-orbit assembly. ESA

N88-16810*# Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.
KINETIC ISOLATION TETHER EXPERIMENT Annual Report
J. David Powell, Xiaohua He, and Robert Schoder Feb. 1988 45 p
(Contract NCC2-389)
(NASA-CR-182458; NAS 1.26:182458) Avail: NTIS HC A03/MF A01 CSCL 22B

Progress was made on the analysis of tether damping and on experimentation of the control system on the laboratory simulator. The damping analysis considers the dynamics of a long tether connecting two spacecraft in Earth orbit, one of the spacecraft having dominant mass. In particular, it considers the material damping of the tether. The results show that, with properly chosen tether material and braiding structure, longitudinal vibration of the tethered system is well damped. A particularly effective method of implementing attitude control for tethered satellites is to use the tether tension force to generate control torques by moving the tether attach point relative to the satellite center of mass. A scaled, one dimensional laboratory simulation of the KITE mission was built and preliminary experiments of the proposed attitude control system were performed. The simulator was built to verify theoretical predictions of attitude controllability, and to investigate the technological requirements in order to implement this concept. A detailed description of the laboratory apparatus is provided, and in addition, the results of the preliminary experiments are presented and discussed. Author

N88-16811# Commonwealth Scientific and Industrial Research Organization, Mordialoc (Australia). Div. of Atmospheric Research.
TECHNICAL ASSESSMENT OF THE JOINT CSIRO/BUREAU OF METEOROLOGY PROPOSAL FOR A GEOSTATIONARY IMAGER/SOUNDER OVER THE AUSTRALIAN REGION
D. M. OBrien and R. M. Mitchell 1987 56 p
(RTP-15) Copyright Avail: NTIS HC A04/MF A01

A combined imager/sounder for geostationary orbit over the Australian region was proposed. The Imaging Spectrometer and Atmospheric Sounder (ISAS) was to provide: visible imagery with high spatial and spectral resolution; infrared imagery with both high spatial resolution and low noise equivalent differential temperature (NE Delta T) at 300 K; and infrared sounding with low NE Delta T. The technical feasibility of the proposal is assessed. The principal findings and recommendations are listed. B.G.

N88-16812*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
EMULATING A FLEXIBLE SPACE STRUCTURE: MODELING
H. B. Waites, S. C. Rice, and V. L. Jones (Control Dynamics Co., Huntsville, Ala.) Feb. 1988 22 p
(NASA-TM-100320; NAS 1.15:100320) Avail: NTIS HC A03/MF A01 CSCL 22B

Control Dynamics, in conjunction with Marshall Space Flight Center, has participated in the modeling and testing of Flexible Space Structures. Through the series of configurations tested and the many techniques used for collecting, analyzing, and modeling the data, many valuable insights have been gained and important lessons learned. This paper discusses the background of the Large Space Structure program, Control Dynamics' involvement in testing and modeling of the configurations (especially the Active Control Technique Evaluation for Spacecraft (ACES) configuration), the results from these two processes, and insights gained from this work. Author

N88-16734# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Attitude and Orbit Control Div.
CONTROL AND STABILIZATION OF ESA SATELLITES
D. N. Soo *In its* ESA Bulletin No. 10 Aug. 1977 p 38-43
(For primary document see N88-16728 09-12)
Avail: NTIS HC A05/MF A01

N88-16737# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Structures and Thermal Control Div.
WHY MECHANISMS ARE CRITICAL TO SPACECRAFT PERFORMANCE
H. M. Briscoe *In its* ESA Bulletin No. 10 Aug. 1977 p 56-59 (For primary document see N88-16728 09-12)
Avail: NTIS HC A05/MF A01

N88-16740# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Test and Engineering Services Div.
MAJOR SPACECRAFT HARDWARE TESTING IN EUROPE
K. H. Heffels *In its* ESA Bulletin No. 10 Aug. 1977 p 72-76 (For primary document see N88-16728 09-12)
Avail: NTIS HC A05/MF A01

N88-16758# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Directorate of Applications Programs.
THE ROLE OF THE L-SAT PROGRAM IN THE EVOLUTION OF EUROPEAN COMMUNICATIONS SATELLITES
B. L. Herdan *In its* ESA Bulletin No. 24 Nov. 1980 p 28-33 (For primary document see N88-16755 09-12)
Copyright Avail: NTIS HC A05/MF A01

N88-16759# European Space Agency. Centre Spatial de Toulouse (France). Div. du Programme Meteosat.
THE METEOSAT OPERATIONAL PROGRAM [LE PROGRAMME OPERATIONALE METEOSAT]
P. Louis *In its* ESA Bulletin No. 24 Nov. 1980 p 34-39 In FRENCH (For primary document see N88-16755 09-12)
Copyright Avail: NTIS HC A05/MF A01

N88-16769# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Communications Satellite Dept.
SATELLITE ASSEMBLY IN GEOSTATIONARY ORBIT: A PLUG-AND-SOCKET CONCEPT
A. W. Preukschat *In its* ESA Bulletin No. 25 Feb. 1981 p 10-15 (For primary document see N88-16767 09-12)
Avail: NTIS HC A05/MF A01

N88-16779# European Space Agency, Paris (France).
POLAR PLATFORM ELEMENT OF SPACE STATION: MISSION OBJECTIVES, EUROPEAN PRIORITIES, CANDIDATE INSTRUMENTATION AND SELECTION PROCEDURE
G. Duchossois *In its* Proceedings of the ESA Workshop on Co-Orbiting Platform Elements (COPE) Sep. 1987 p 13-16 (For primary document see N88-16777 09-12)
Copyright Avail: NTIS HC A04/MF A01

N88-16780# European Space Agency, Paris (France). Space Station and Platforms Directorate.
SPACE STATION OVERVIEW
G. P. Haskell *In its* Proceedings of the ESA Workshop on Co-Orbiting Platform Elements (COPE) Sep. 1987 p 17-20 Original contains color illustrations (For primary document see N88-16777 09-12)
Copyright Avail: NTIS HC A04/MF A01

N88-16781# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Systems Engineering Dept.
TETHERS: AN OUTLINE OF A NEW CONCEPT FOR EARTH OBSERVATION
C. A. Markland *In its* Proceedings of the ESA Workshop on Co-Orbiting Platform Elements (COPE) Sep. 1987 p 21-23 (For primary document see N88-16777 09-12)
Copyright Avail: NTIS HC A04/MF A01

N88-17223*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
DEVELOPMENT OF A COUPLED EXPERT SYSTEM FOR THE SPACECRAFT ATTITUDE CONTROL PROBLEM
K. Kawamura, G. Beale, J. Schaffer, B.-J. Hsieh, S. Padalkar, J. RodriguezMoscoso (Vanderbilt Univ., Nashville, Tenn.), F. Vinz, and K. Fernandez *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 125-132 (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 22B

N88-17239*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
DESIGN KNOWLEDGE CAPTURE FOR THE SPACE STATION
K. R. Crouse and D. B. Wechsler (Mitre Corp., Houston, Tex.) *In its* First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 239-245 (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 22B

N88-17254*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
EXPERT SYSTEM APPLICATIONS IN SPACECRAFT SUBSYSTEM CONTROLLERS
Paul F. Marshall *In its* First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 349-353 (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 22B

19 SPACECRAFT INSTRUMENTATION

For related information see also *06 Aircraft Instrumentation* and *35 Instrumentation and Photography.*

N88-16813# Tuebingen Univ. (West Germany). Fakultaet fuer Physik.
EXPERIMENT CONTROL AND DATA SYSTEM FOR AN INFRARED DETECTOR ARRAY WITH MAXIMUM SENSITIVITY
Ph.D. Thesis
Rolf G. Jaacks 1986 96 p In GERMAN; ENGLISH summary (ETN-88-91497) Avail: NTIS HC A05/MF A01

An infrared detector array for astronomical observations from space, limited in sensitivity only by the background light scattered off interplanetary dust particles (Zodiacal light) was developed. The array comprises 36 photoconductive detectors, arranged in 4 rows, with each row having a different spectral response. The full array covers the range from 3 to 120 microns. This cryogenic array was built as one of the focal plane instruments for a liquid-helium-cooled 50 cm telescope, to be flown on the Space Shuttle. An experiment processor for this application to allow automated control of the housekeeping functions and executing the scientific observing program was built. A modular data acquisition system, parallel for all detectors, with 20 bit, according to a dynamic range of 1 million, and a resolution of 12 bit was developed. Software for testing and operation was written and verified. A ground station was built around an LSI11/23 minicomputer together with a 1024x1024x8 image processing system, so that it can also be used for science data evaluation.
ESA

20 SPACECRAFT PROPULSION AND POWER

Includes main propulsion systems and components, e.g., rocket engines; and spacecraft auxilliary power sources.

For related information see also *07 Aircraft Propulsion and Power, 28 Propellants and Fuels, 44 Energy Production and Conversion,* and *15 Launch Vehicles and Space Vehicles.*

N88-16719# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). GEOS Div.
A EUROPEAN APOGEE BOOST MOTOR FOR GEOS
J. A. Steinz *In its* ESA Bulletin No. 8 Feb. 1977 p 3-7 (For primary document see N88-16718 09-12)
Avail: NTIS HC A05/MF A01

N88-16735# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Attitude and Orbit Control Div.
ELECTRIC PROPULSION: A CONTROVERSIAL MUST FOR LONG-LIVED APPLICATIONS SATELLITES
H. A. Pfeffer *In its* ESA Bulletin No. 10 Aug. 1977 p 44-48 (For primary document see N88-16728 09-12)
Avail: NTIS HC A05/MF A01

N88-16751# Societe Europeenne de Propulsion, Vernon (France).
INTEGRATION TESTING OF THE PROPULSION SYSTEM OF ARIANE'S FIRST STAGE
A. Souchier *In* ESA, ESA Bulletin No. 15: Ariane, the European Launcher for the 1980's Aug. 1978 p 63-66 (For primary document see N88-16741 09-12)
Copyright Avail: NTIS HC A05/MF A01

N88-16753# Centre National d'Etudes Spatiales, Paris (France). Ariane Project Team.
THE HM-7 ENGINE OF ARIANE'S THIRD STAGE
J. Borromee and Ph. Lesage *In* ESA, ESA Bulletin No. 15: Ariane, the European Launcher for the 1980's Aug. 1978 p 71-77 (For primary document see N88-16741 09-12)
Copyright Avail: NTIS HC A05/MF A01

N88-17063# Boeing Aerospace Co., Seattle, Wash.
QUALIFICATION BY ANALYSIS OF IUS PLUME DEFLECTORS
R. F. Hain *In* Shock and Vibration Information Center The Shock and Vibration Bulletin. Part 4: Structural Dynamics and Modal Test and Analysis Jan. 1987 p 1-7 (For primary document see N88-17062 09-39)
Avail: NTIS HC A07/MF A01 CSCL 21H

23 CHEMISTRY AND MATERIALS (GENERAL)

N88-16814# Harvard Univ., Cambridge, Mass. Dept. of Chemistry.
MONOLAYER FILMS PREPARED BY THE SPONTANEOUS SELF-ASSEMBLY OF SYMMETRICAL AND UNSYMMETRICAL DIALKYL SULFIDES FROM SOLUTION ONTO GOLD SUBSTRATES: STRUCTURE, PROPERTIES, AND REACTIVITY OF CONSTITUENT FUNCTIONAL GROUPS
Ernest B. Troughton, Colin D. Bain, George M. Shitesides, Ralph G. Nuzzo, and David L. Allara Oct. 1987 88 p Prepared in cooperation with Bell Telephone Lab., Murray Hill, N.J., and Bell Communications Research, Red Bank, N.J.
(Contract N00014-85-K-0898)
(AD-A186717; TR-3) Avail: NTIS HC A05/MF A01 CSCL 07B

Exposure of evaporated gold films supported on silicon wafers to solutions of dialkyl sulfides (R(CH2)m-S-(CH2)n-R'; R and R'=CH3 or CO2H) or alkyl thiols (R(CH2)nSH, R=CO2H or CH3) in methanol or ethanol results in rapid formation of a monolayer of the organosulfur compound adsorbed onto the gold. The resulting films have been characterized using a number of techniques, including X-ray photoelectron spectroscopy (XPS), infrared spectroscopy (IRS), ellipsometry, and wetting. These self-assembled, supported organic monolayer films are systems that can be used to study problems in the physical-organic chemistry and materials science of organic surfaces, especially the relation between the molecular-level structure of the film constituents and the macroscopic properties of the assembled monolayers. GRA

24 COMPOSITE MATERIALS

Includes physical, chemical, and mechanical properties of laminates and other composite materials.

For ceramic materials see *27 Nonmetallic Materials.*

N88-16815# Georgia Inst. of Tech., Atlanta. School of Aerospace Engineering.
SUBLAMINATE DAMAGE MECHANISMS IN COMPOSITE STRUCTURES Final Report, 15 Apr. 1985 - 14 Apr. 1987
Lawrence W. Rehfield and Erian A. Armanios Jul. 1987 44 p
(Grant AF AFOSR-0179-85)
(AD-A186807; AFOSR-87-1450TR) Avail: NTIS HC A03/MF A01 CSCL 11D

This final report summarizes the objectives and accomplishments of research on sublaminate damage mechanisms in composite structures. It may be separated into three elements. The first is interlaminar fracture analysis methodology development. Existing methods for predicting strain energy release rate components have been assessed, and two new alternative approaches have been developed and illustrated. The second is the creation of a phenomenologically based criterion for damage tolerance analysis of composite structures. An equivalent damage parameter and a relevant compliance measure are determined from experiments. This methodology has been validated by seven independent experiments. GRA

N88-16816# Southwest Research Inst., San Antonio, Tex.
MICROMECHANISMS OF FATIGUE CRACK GROWTH AND FRACTURE TOUGHNESS IN METAL MATRIX COMPOSITES Interim Technical Report, 31 Jul. - 31 Oct. 1987
D. L. Davidson Nov. 1987 28 p
(Contract N00014-85-C-0206)
(AD-A186941; SWRI-06-8602) Avail: NTIS HC A03/MF A01 CSCL 11D

Fracture toughness of several composites of aluminum alloys reinforced with particulate SiC have been measured. Variables were particulate size and volume fraction, and matrix alloy composition and heat treatment. Fracture surface profiles were measured and related to fractile dimension using the techniques of quantitive metallography. Fracture surface roughness was described well by fractals, but fracture toughness did not correlate with any measure of fracture roughness. An explanation for this behavior is offered. GRA

N88-16817# Virginia Univ., Charlottesville. Dept. of Materials Science.
INVESTIGATION OF MICROSTRUCTURAL FACTORS THAT CAUSE LOW FRACTURE TOUGHNESS IN SILICON CARBIDE WHISKER/Al ALLOY COMPOSITES Annual Report, 1 Sep. 1986 - 30 Sep. 1987
F. E. Wawner and C. R. Harris Sep. 1987 106 p
(Contract N00014-85-K-0179)
(AD-A186443; UVA/525398/MS88/102) Avail: NTIS HC A06/MF A01 CSCL 11D

This investigation deals with factors influencing the fracture toughness in silicon carbide whisker aluminum alloy composites.

There is an enormous amount of variables which can, independently or in combination, yield different properties in these materials. Chemical composition, manufacturing techniques and processing, along with the material's history, must all be considered for a complete understanding of the material's behavior. The approach employed here is to evaluate strength parameters in order to gauge the effectiveness of one variable, individually altered, while all other variables remain constant. For example, ultimate tensile strength was one parameter measured before and after a certain heat treatment. Any observed changes in strength were then investigated on a microstructural level, using electron microscopy and X-ray techniques. Ideally, an explanation for the phenomenon can be found and a model proposed to explain or predict the behavior. GRA

N88-16818# British Aerospace Public Ltd. Co., Woodford (England). Structures Dept.
FATIGUE AND DAMAGE TOLERANCE DESIGN DATA FOR CARBON FIBRE COMPOSITES Final Report
G. S. Ridley and D. J. Cropper Nov. 1986 82 p
(Contract MOD-A93b/474)
(BAe-MSM-R-GEN-0454; BR101644; ETN-88-91514) Copyright Avail: NTIS HC A05/MF A01

Control static tests for carbon/epoxy laminates show a reduction in static strength, in tension and compression, for an increase in test temperature over the range from minus 50 to plus 120 C. Room temperature constant amplitude fatigue tests reveal that an increase in moisture content from 0.4 percent to 1.0 percent by weight does not affect the fatigue endurance of two laminates to any discernible pattern. In room temperature constant amplitude fatigue plus residual static strength tests, reduction in strength greater than 5 percent occurs in 15 percent of the specimens. In environmental constant amplitude fatigue tests a decrease in fatigue endurance is realized for an increase in test temperature from minus 50 to plus 90 C. In environmental constant amplitude fatigue plus residual static strength tests a reduction in strength of greater than 5 percent, when compared to the static control tests, occurs in 32 percent of the specimens. Environmental FALSTAFF fatigue tests show a much lower fatigue endurance than the equivalent room temperature FALSTAFF tests. ESA

N88-16819# Bath Univ. (England). Schools of Materials Science and Mechanical Engineering.
FATIGUE BEHAVIOUR OF HYBRID COMPOSITES Final Progress Report
T. Adam, R. F. Dickson, G. Fernando, B. Harris, and H. Reiter Jan. 1987 96 p
(Contract MOD-2112/052-XR/MAT)
(BR102236; ETN-88-91546) Avail: NTIS HC A05/MF A01

Hybrid fiber/resin composite materials properties were studied. Design implications of hybrids for aerospace use were assessed. Fatigue resistance of hybrids (mainly carbon/Kevlar) was determined, and fractography studies were carried out. Carbon/Kevlar laminate and carbon/glass laminate fatigue behavior was determined. ESA

N88-16820# Surrey Univ., Guildford (England). Dept. of Materials Science and Engineering.
EFFECTS OF PROCESSING VARIABLES ON THE BEHAVIOR OF E-GLASS/913 AND XAS CARBON FIBRE/913 LAMINATES SUBJECTED TO HOT/WET ENVIRONMENTAL CONDITIONS Final Report
F. R. Jones, comp., M. G. Bader, M. A. Shah, L. Boniface, and T. Nensi Feb. 1987 104 p
(Contract MOD-2064/072-XR/MAT)
(BR101940; ETN-88-91547) Avail: NTIS HC A06/MF A01

The effect of processing variables on the hot-wet performance of glass reinforced plastic laminates was studied under three different environmental conditions. The processing variables examined included curing and post-curing times and temperatures, and dwell times. The effect of varying the amount of curing agent in the resin system was also examined. Significant concentrations of residual curing agent are found in the standard laminates. A distinct relationship between the level of residual curing agent in laminates and their moisture absorption characteristics is identified. Specimen width and fiber orientation are also found to affect the rate of moisture uptake and long-term weight changes. No significant deleterious effects on the mechanical performance of the laminates are observed. ESA

N88-16821# Surrey Univ., Guildford (England). Dept. of Materials Science and Engineering.
THE STRENGTH OF HYBRID COMPOSITES Final Report
M. J. Pitkethly and M. G. Bader Jan. 1987 264 p
(Contract MOD-2064/78-XR/MAT)
(BR101991; ETN-88-91548) Avail: NTIS HC A12/MF A01

The strength of carbon fibers in unidirectional hybrid composites of glass and carbon fibers was investigated. It is shown that the strength distributions of bundles of carbon fibers impregnated with resin, unsupported and in a hybrid, may be described by the Weibull model. Strength decreases when the bundle spacing is less than a critical distance but at very low spacings the strength begins to increase again. Hybrid composites exhibit a greater strength over impregnated bundles. A hypothesis is proposed to explain this phenomenon which combines thermal effects with the constraining influence of the glass and the differences in the severity of flaws in hybrid bundles. The type of hybrid specimen tested enables the fracture process in the composite to be followed closely. Results support the model for composite strength proposed by Batdorf (1982) the critical i-plet model. ESA

N88-16822# Aeronautical Research Inst. of Sweden, Stockholm. Aerodynamics Dept.
EFFECT OF LOW VELOCITY IMPACT ON COMPRESSION STRENGTH OF A QUASI-ISOTROPIC LAMINATE
Klas Levin Aug. 1987 18 p Previously announced in IAA as A87-46018
(Contract FMV-F-K-82250-85-076-73-001)
(FFA-TN-1987-38; ETN-88-91667) Avail: NTIS HC A03/MF A01

Impact tests were conducted on composite panels using a falling weight to simulate low velocity impact which might occur in manufacturing and maintenance operations. Compressive strength after impact was examined on coupons cut out from the panels, to correlate compressive strength with the impact energy levels and damage sizes when varying laminate fiber content, thickness, temperature at impact, and impactor diameter. Laminates with low fiber content have lower energy level for obtaining a visible impact damage than high fiber content laminates. Higher impact energy results in larger impact damage and changed damage pattern. No simple correlation between internal damage size and compressive failure strain exists. The damage pattern therefore influences the failure strain. Differences in minimum compressive strength due to laminate thickness are small, although the energy required to obtain barely visible impact damage is not reached for the thick laminates. ESA

N88-16823# Messerschmitt-Boelkow-Blohm G.m.b.H., Bremen (West Germany).
MOISTURE PLOTTING OF CARBON FIBER COMPOSITE IN FLIGHT OPERATIONS [FEUCHTEAUFNAHME VON CFK IM FLUGBETRIEB]
I. Kroeber 1987 26 p In GERMAN Presented at the DGLR Symposium on Entwicklung und Anwendung von Faserverbund-Strukturen', Berlin, Federal Republic of Germany, 14-15 May 1987
(MBB-UT-119/87; ETN-88-90793) Avail: NTIS HC A03/MF A01

The data of the proposed flight simulation model agree with those of the samples fixed on the aircraft. The maximal moisture content of the composite material depends mostly on the relative humidity of the air. The annual variations in the climates cause a difference in the moisture content of carbon fiber composite of 1.4 mm in depth. The upper limit of the relative humidity is 86 percent. ESA

N88-16824# Messerschmitt-Boelkow-Blohm G.m.b.H., Bremen (West Germany).
INTEGRITY CONTROL OF CARBON FIBER REINFORCED PLASTICS (CFRP) STRUCTURAL ELEMENTS. CONCLUSION WITH RESPECT TO THE CONTROL METHODOLOGY OF CFRP PRIMARY STRUCTURES IN MANNED SPACE FLIGHT AND THE IMPLICATIONS TO THE DESIGN, ANALYSIS AND TESTING OF CFRP STRUCTURAL ELEMENTS, EXECUTIVE SUMMARY Supplement to Final Report
Werner H. Paul Paris, France ESA 1985 87 p
(Contract ESA-4442/80-NL-AK(SC))
(MBB-TR-RB517-014/85; ESA-CR(P)-2517; ETN-88-91709)
Avail: NTIS HC A05/MF A01

A three fold control logic related to development, manufacturing, and operation of safety relevant structures is established in order to exclude catastrophic failures of CFRP-elements due to the existence of global degradation or local defects. Verification of integrity control requirements during development; design concepts for critical structural items; global deviations and local defects; stress evaluation; material properties; the impact of macroscopic defects on the static capability; the degradation of capabilities with increasing operational life; nondestructive inspection of CFRP elements; and a simplified design procedure are discussed. ESA

N88-16825*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
REVIEW OF THERMAL PROPERTIES OF GRAPHITE COMPOSITE MATERIALS
D. A. Kourtides Dec. 1987 52 p Presented at the Fire Retardant Chemicals Association Conference, Monterey, Calif., 18-21 Oct. 1987
(NASA-TM-100049; NAS 1.15:100049) Avail: NTIS HC A04/MF A01 CSCL 11D

Flammability, thermal, and selected mechanical properties of composites fabricated with epoxy and other thermally stable resin matrices are described. Properties which were measured included limiting-oxygen index, smoke evolution, thermal degradation products, total-heat release, heat-release rates, mass loss, flame spread, ignition resistance, thermogravimetric analysis, and selected mechanical properties. The properties of 8 different graphite composite panels fabricated using four different resin matrices and two types of graphite reinforcement are described. The resin matrices included: XU71775/H795, a blend of vinyl polystyryl pyridine and bismaleimide; H795, a bismaleimide; Cycom 6162, a phenolic; and PSP 6022M, a polystyryl pyridine. The graphite fiber used was AS-4 in the form of either tape or fabric. The properties of these composites were compared with epoxy composites. It was determined that the blend of vinyl polystyryl pyridine and bismaleimide (XU71775/H795) with the graphite tape was the optimum design giving the lowest heat release rate.
Author

N88-16826# Oak Ridge National Lab., Tenn.
MICROSTRUCTURES AND PROPERTIES OF SiC WHISKER-REINFORCED MULLITE COMPOSITES
T. N. Tiegs, P. F. Becher, and P. Angelini 1987 16 p Presented at the 1st International Workshop on Mullite, Tokyo, Japan, 9 Nov. 1987
(Contract DE-AC05-84OR-21400)
(DE88-002611; CONF-871189-1) Avail: NTIS HC A03/MF A01

Mullite is an attractive material for certain structural applications because of its excellent phase stability, low thermal conductivity, excellent creep resistance, and high temperature strength retention, as compared to other engineering ceramic materials. However, mullite suffers from low strength and fracture toughness. Results at ORNL showed significant improvement in both strength and toughness of mullite with the addition of 20 volume percent SiC whiskers. The improved strength is retained up to elevated temperatures; however, at temperatures greater than 1200 C the strength is dependent on the secondary phases present at the grain boundaries. DOE

N88-16827# National Aerospace Lab., Tokyo (Japan).
MECHANICAL PROPERTIES OF CARBON FIBER REINFORCED THERMOPLASTIC MATRIX COMPOSITES
Yoshio Noguchi 1987 15 p In JAPANESE; ENGLISH summary
(NAL-TR-934; ISSN-0389-4010) Avail: NTIS HC A03/MF A01

Carbon fiber reinforced thermoplastic (CFRTP) composites have a great potential for use in aircraft structures especially where toughness is concerned. In this study, experiments are conducted on a fabric-CFRTP and fabric CFRP composites subjected to the effect of elevated temperature on short beam shear strength and flexural fatigue strength. Composites were fabricated from carbon fiber 8-harness satin fabric reinforced with two thermoplastic matrices, polyethersulphon (PES) and polyetheretherketon (PEEK) and compared with those of an epoxy matrix system. The CFTRP laminates were prepared by the film stacking method, namely thermoplastic resin films and carbon fiber fabric were stacked alternately then consolidated into a laminate by heat and pressure. Short beam shear tests were performed under environmental conditions at temperatures of 25 to 180 C. Flexural fatigue tests were performed at a room temperature of 25 C and elevated temperatures of 80 to 90 and 130 to 140 C. Short beam shear strength under elevated temperature conditions for fabric-CFRTP is comparable to that obtained with most fabric-CFRP. The fatigue failure specimens indicated that the tough thermoplastic matrix system shows an improved fatigue behavior compared to the brittle epoxy matrix system, mainly due to resistance to the initiation and growth of fatigue damage related to the matrix. Author

N88-16828*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
DESIGN PROCEDURES FOR FIBER COMPOSITE BOX BEAMS
Christos C. Chamis and Pappu L. N. Murthy (Cleveland State Univ., Ohio.) Feb. 1988 25 p
(NASA-TM-100296; E-3296; NAS 1.15:100296) Avail: NTIS HC A03/MF A01 CSCL 11D

Step-by-step procedures are described which can be used for the preliminary design of fiber composite box beams subjected to combined loadings. These procedures include a collection of approximate closed-form equations so that all the required calculations can be performed using pocket calculators. Included is an illustrated example of a tapered cantilever box beam subjected to combined loads. The box beam is designed to satisfy strength, displacement, buckling, and frequency requirements. Author

N88-16829# Virginia Polytechnic Inst. and State Univ., Blacksburg. Center for Composite Materials and Structures.
FINITE ELEMENT ANALYSIS OF DAMAGED CROSS-PLY COMPOSITE LAMINATES
Elizabeth A. Strauss and Carl T. Herakovich Jul. 1987 127 p Sponsored by Hercules, Inc., Magna, Utah
(CCMS-87-10; VPI-E-87-11) Avail: NTIS HC A07/MF A01

The problem of transverse cracks in T300/5208 graphite-epoxy cross-ply laminates was studied using generalized plane strain finite element analysis. The degradation of elastic modulus, Poisson's ratio, shear modulus, and coefficient of thermal expansion was predicted and then compared with analytical models and experimental data. The elastic modulus was predicted to exhibit relatively small degradation as a function of crack density as compared to the Poisson's ratio, shear modulus, and coefficient of thermal expansion which were predicted to have large degradations. The resulting state of stress was also studied for several crack spacings. Interlaminar stresses were predicted to form as a result of the free surface of the crack. The crack tip also caused all the nonzero stresses to exhibit singular behavior at the crack tip. Author

N88-16634*# Army Research and Technology Labs., Fort Eustis, Va. Aerostructures Directorate.
DELAMINATION DURABILITY OF COMPOSITE MATERIALS FOR ROTORCRAFT
T. Kevin OBrien *In* NASA, Washington, NASA/Army Rotorcraft Technology. Volume 2: Materials and Structures, Propulsion and

Drive Systems, Flight Dynamics and Control, and Acoustics Feb. 1988 p 573-605 (For primary document see N88-16632 09-01)
Avail: NTIS HC A25/MF A01 CSCL 11D

N88-16700*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
HIGH TEMPERATURE POLYMER MATRIX COMPOSITES
Michael A. Meador *In its* Aeropropulsion '87. Session 1: Aeropropulsion Materials Research Nov. 1987 15 p (For primary document see N88-16697 09-07)
Avail: NTIS HC A06/MF A01 CSCL 11D

N88-16702*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
DEVELOPMENT OF A NEW GENERATION OF HIGH-TEMPERATURE
Pamela K. Brindley *In its* Aeropropulsion '87. Session 1: Aeropropulsion Materials Research Nov. 1987 15 p (For primary document see N88-16697 09-07)
Avail: NTIS HC A06/MF A01 CSCL 11D

25 INORGANIC AND PHYSICAL CHEMISTRY

Includes chemical analysis, e.g., chromatography; combustion theory; electrochemistry; and photochemistry.

For related information see also *77 Thermodynamics and Statistical Physics.*.

N88-16830*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
A RAPID METHOD FOR THE COMPUTATION OF EQUILIBRIUM CHEMICAL COMPOSITION OF AIR TO 15000 K
Ramadas K. Prabhu (Planning Research Corp., Hampton, Va.) and Wayne D. Erickson Mar. 1988 31 p
(NASA-TP-2792; L-16375; NAS 1.60:2792) Avail: NTIS HC A03/MF A01 CSCL 07D

A rapid computational method has been developed to determine the chemical composition of equilibrium air to 15000 K. Eleven chemically reacting species, i.e., O2, N2, O, NO, N, NO+, e-, N+, O+, Ar, and Ar+ are included. The method involves combining algebraically seven nonlinear equilibrium equations and four linear elemental mass balance and charge neutrality equations. Computational speeds for determining the equilibrium chemical composition are significantly faster than the often used free energy minimization procedure. Data are also included from which the thermodynamic properties of air can be computed. A listing of the computer program together with a set of sample results are included. Author

N88-16831# Naval Postgraduate School, Monterey, Calif.
A HOLOGRAPHIC INVESTIGATION OF PARTICULATES IN METALLIZED SOLID FUEL RAMJET COMBUSTION M.S. Thesis
Crawford A. Easterling, III Sep. 1987 57 p
(AD-A186887) Avail: NTIS HC A04/MF A01 CSCL 21H

An investigation was conducted pursuant to the development of a holographic technique to be used in the study of particulates in metallized solid fuel ramjet combustion. Additionally, a technique for generating a time-space dependent temperature profile of a two-dimensional solid fuel ramjet fuel slab was developed. A holocamera was designed and constructed for use with a two-dimensional solid fuel ramjet. Eleven micron resolution was obtained using diffuse illumination. Initial attempts to obtain holograms were unsuccessful. The fuels tested either would not sustain or, produced copious amounts of smoke which precluded a sufficiently intense scene beam from reaching the holographic plate. Use of 0.005 inch diameter, Chromel-Alumel thermocouples, imbedded at measured depths in the fuel slab, provided subsurface temperature data as a function of time and location, until exposed to free stream conditions. GRA

N88-16832# Naval Postgraduate School, Monterey, Calif.
HOLOGRAPHIC INVESTIGATION OF METALLIZED SOLID PROPELLANT COMBUSTION IN TWO-DIMENSIONAL AND THREE-DIMENSIONAL ROCKET MOTORS M.S. Thesis
J. D. Walker Sep. 1987 46 p
(AD-A187000) Avail: NTIS HC A03/MF A01 CSCL 21H

This experimental investigation included the design and construction of a new, two-dimensional, rocket motor that could be used to obtain better holographic data than obtained in previous investigations using a small three-dimensional motor. The solid propellant used during this investigation was AP, HTPB, with 2 percent, 40 micron aluminum particles and 0.25 percent iron oxide. Good quality holograms were obtained using the three dimensional motor at operating pressures of 93 and 94 psia. Successful holographic recordings were also acquired using the new, two dimensional motor at pressures of 45 and 183 psia. System limitations and suggested improvements to the apparatus are discussed. GRA

N88-16833# Air Force Astronautics Lab., Edwards AFB, Calif.
THE CORRELATION OF HMX (CYCLOTETRAMETHYLENE-TETRANITRAMINE) PARTICLE CHARACTERIZATION TECHNIQUES TO PROPELLANT BURN RATE Interim Report, Mar. 1986 - Mar. 1987
Kurt G. Chandler Sep. 1987 20 p
(AD-A187119; AFAL-TR-87-039) Avail: NTIS HC A03/MF A01 CSCL 19A

Present methods of correlating solid propellant burn rate to oxidizer particle parameters solely depend upon the weight median diameters of the particle distribution. With the broad and variable distribution of the oxidizer particle, vastly different particle surface areas may result in variations in propellant burn rates. This study compares the burn rate of solid propellant to weight median diameters, calculated surface areas from size measurements, measured surface areas, and a new surface area distribution dependent solvolysis method. Comparison of the characterization techniques is performed to determine the role of surface area in the burning process, and the best parameter for propellant burn rate correlations. GRA

N88-16834# Wayne State Univ., Detroit, Mich. Dept. of Chemistry.
SURFACE COMPOSITION-REACTIVITY RELATIONSHIPS IN HETEROGENEOUS CATALYSIS Progress Report
A. Brenner 10 Dec. 1986 7 p
(Contract DE-AC02-79ER-10381)
(DE87-003450; DOE/ER-10381/8) Avail: NTIS HC A02/MF A01

The primary objectives of the research during the second year of the grant were as follows: (1) Continue work on the temperature programmed reduction and oxidation (TPR/TPO) of supported metals. (2) Determine the activity for H2-D2 exchange over Fe2O3 as a function of its pretreatment. (3) Attempt to develop a chemisorption technique for measuring the dispersion of supported Mo. (4) Measure the isotopic composition of the products of ethylene deuterogenation over supported Mo. The results are reported in each area of research. DOE

N88-16835# Southampton Univ. (England). Dept. of Chemistry.
HIGH-TEMPERATURE PHOTOELECTRON SPECTROSCOPY. AN INCREASED SENSITIVITY SPECTROMETER FOR STUDYING VAPOR-PHASE SPECIES PRODUCED AT FURNACE TEMPERATURES GREATER THAN 2000K
A. Morris, J. M. Dyke, G. D. Josland, M. P. Hastings, and P. D. Francis 1986 19 p
(Grant AF AFOSR-0283-83)
(AD-A186542; AFOSR-87-1679TR) Avail: NTIS HC A03/MF A01 CSCL 07D

The construction and performance of a photoelectron spectrometer designed for the vapor-phase study of high-temperature species is described. An inductively heated furnace is used to produce atoms and molecules in the vapor phase at furnace temperatures greater than 2000 K. Electrical

interference is eliminated using pulsed heating and gated electronics. A microchannel plate phosphor silicon-intensified-target camera detector is used for rapid data acquisition to minimize problems caused by time-dependent contamination in the ionization region. A dedicated, menu-driven, firmware-based interface, with key pad control, is utilized. The TV monitoring of the photoelectron line images and use of a video window to select data allow optimum spectral conditions to be preserved during and experiment. Results show reductions in data acquisition times of up to 90 compared to equivalent single-channel detector experiments. GRA

N88-16836# Minnesota Univ., Minneapolis. Dept. of Mechanical Engineering.

HIGH TEMPERATURE SOLAR ELECTROTHERMAL PROCESSING-3. ZINC FROM ZINC OXIDE AT 1200-1675K USING A NON-CONSUMABLE ANODE Final Report

R. D. Palumbo and E. A. Fletcher 9 Sep. 1987 37 p
(Contract N00014-82-K-0523)
(AD-A186600) Avail: NTIS HC A03/MF A01 CSCL 09A

The electrolytic decomposition potential of Zioic Oxide has been studied in a solar furnace in the temperature range 1200 to 1675 K. The electrolyte consisted of various mixtures of calcium fluoride and sodium aluminum fluoride. The measured potentials were close to the thermodynamically predicted values for the reaction. The zero current overvoltages, surprisingly, increased with increasing temperature and the concurrent change in composition. The specific conductances of the electrolytes were estimated in the temperature range 1200 to 1500 K. They increased with increasing temperature and the concurrent change in composition. Various materials were tested for use as electrodes and crucibles. Some of our experiences and our experimental techniques are described. GRA

N88-16837# Technische Hogeschool, Delft (Netherlands). Dept. of Aerospace Engineering.

DESIGN OF A SOLID FUEL COMBUSTION CHAMBER [ONTWERP VAN EEN VASTE BRANDSTOF VERBRANDINGSKAMER]

P. A. O. G. Korting Feb. 1985 49 p In DUTCH Prepared in cooperation with Prins Maurits Lab. TNO
(Contracts STW-DLR-14.0120; SPE-90753.40)
(VTH-LR-447; PML-1985-C-1; SFCC-22; B8707429;
ETN-87-90196) Avail: NTIS HC A03/MF A01

A solid fuel combustion chamber was designed to study combustion processes. The most important aspects of the flow and combustion process in a solid fuel combustion chamber are explained. The properties of two fuels suitable for the investigation are discussed. The interior ballistics design, which determines the most important sizes of the combustion chamber, is described. The design of the nozzle, which can melt in case of long burn times, is presented. The most important design parameters are summarized. Author (ESA)

N88-16838# Technische Hogeschool, Delft (Netherlands). Dept. of Aerospace Engineering.

INVESTIGATION OF THE FLOW AND COMBUSTION BEHAVIOR IN A SOLID FUEL COMBUSTION CHAMBER, INCLUDING THE MEASURING PROGRAM [ONDERZOEK NAAR HET STROMINGS- EN VERBRANDINGSGEDRAG IN EEN VASTE BRANDSTOF VERBRANDINGSKAMER INCLUSIEF MEETPROGRAMMA]

P. A. O. G. Korting Mar. 1985 37 p In DUTCH Prepared in cooperation with Prins Maurits Lab. TNO
(Contracts STW-DLR-14.0120; PBE-90753.140)
(VTH-LR-460; PML-1985-C-9; SFCC-26; B8707438;
ETN-87-90205) Avail: NTIS HC A03/MF A01

The flow and combustion processes in a solid fuel combustion chamber were studied. The different processes occurring in such a combustion chamber are introduced. Results from other investigations in similar chambers are discussed; they show which parameters affect the flow and combustion behavior, but do not reveal the internal correlations. The measuring program, and diagnostic techniques are presented. Author (ESA)

N88-16839# Technische Hogeschool, Delft (Netherlands). Dept. of Aerospace Engineering.

DESIGN OF A GAS MASS FLOW CONTROL SYSTEM FOR THE GAS INLET INSTALLATION OF A SOLID FUEL COMBUSTION CHAMBER [HET ONTWERP VAN EEN GASMASSASTROOM REGELSYSTEEM TEN BEHOEVE VAN DE GASTOEVOERINSTALLATIE VOOR DE VASTE BRANDSTOP VERBRANDINGSKAMER]

J. P. M. Versmissen Jul. 1985 37 p In DUTCH Prepared in cooperation with Prins Maurits Lab. TNO
(VTH-LR-471; PML-1985-C-53; SFCC-19; B8707445;
ETN-87-90211) Avail: NTIS HC A03/MF A01

The control engineering construction of combustion chamber gas inlet pipes was examined for the realization of the control system. The gas mass flow rate in the pipes was measured by a sonic control and measuring choke (SCMC). The gas inlet pipe with the choke behaves as a first order system. The time constants and amplification factors were determined, leading to a control systems design which makes it possible to influence the pressure (and hence the mass flow) in front of the SCMC. In practice, the system fulfills the requirements. The mass flow in the oxygen inlet can be controlled with a 2 percent accuracy, depending on the pressure. Author (ESA)

N88-16840# Technische Hochschule, Darmstadt (West Germany). Fachbereich Physik.

HETEROGENEOUS ISOTOPE EXCHANGE BETWEEN SOLID CESIUM IODIDE AND GASEOUS METHYL IODIDE Ph.D. Thesis [HETEROGENER ISOTOPENAUSTAUSCH ZWISCHEN FESTEM CAESIUMIODID UND GASFOERMIGEM METHYLIODID]

Monika Schmitt Dec. 1985 83 p In GERMAN
(ETN-88-91085) Avail: NTIS HC A05/MF A01

The effect of the different steps of heterogeneous isotope exchange reactions on the evolution of the exchange curves was studied. The theoretical treatment takes into account phenomena occurring at the phase boundary i.e., phase boundary reaction and in the interior of the solid body (i.e., volume diffusion). A discrete diffusion model for transport in the layers close to the surface was developed. Measurements on the system CsI(s)/CH3I/(g) show an exchange already at 50 C. From 200 C on, a catalytic dissociation of methyl iodide due to cesium iodide is observed. Below 130 C, the measurements agree well with the discrete diffusion model. At higher temperatures, the exchange reactions are determined by solid body diffusion. The phase boundary reaction is so fast that it does not affect the measured exchange curves. ESA

N88-16841 National Physical Lab., Teddington (England). Div. of Mechanical and Optical Metrology.

RESULTS FROM A QUESTIONNAIRE ON PARTICULATE METROLOGY IN THE UK

K. G. Birch, D. A. Elkington, and D. C. Havard Jan. 1987 17 p
(NPL-MOM-81; ISSN-0309-3069; ETN-88-91527) Copyright
Avail: Issuing Activity

In order to ascertain the needs of those engaged in particulate metrology within the UK, a questionnaire was distributed to industrial, governmental, and academic establishments. Replies show range and types of measurements performed, the materials measured, and the current use and future needs for certified reference materials and other standards. The need for particle size standards less than 1 micron, for very low surface area materials, i.e., less than 1 sqm/g, and for the extension of higher surface area materials beyond 500 sqm/g is noted. ESA

N88-16842# Technische Hogeschool, Delft (Netherlands). Dept. of Aerospace Engineering.

SOLID FUEL COMBUSTION CHAMBER Tenth Progress Report, Ninth Phase, Jul. - Dec. 1986

H. Wittenberg, P. A. O. G. Korting, C. W. M. vanderGeld, J. B. Vos, T. Wijchers, P. J. M. Elands, G. Klein Lebbink, and R. P. vanderBerg Apr. 1987 43 p Sponsored in cooperation with Technische Hogeschool, Delft, Netherlands and Prins Maurits Lab. TNO Prepared in cooperation with Prins Maurits Lab. TNO

(Contracts STW-DLR-15.0120; PBE-90743.140)
(VTH-LR-515; PML-1987-C-19; SFCC-Pub-43; ETN-88-91564)
Avail: NTIS HC A03/MF A01

Progress in developing a combustion chamber to study flow and combustion processes in solid fuel grains is outlined. An analytical study of laminar channel flows; computational modeling of flow and combustion, employing algebraic finite element methods; computational modeling of build-up and shedding of large vortex structures, employing Lagrangian vortex methods are described. Optical equipment and experiments involving acetylene detection in a flame; two-color pyrometers; particle generators; and soot formation are summarized. ESA

N88-16843# Institut National des Sciences Appliquees de Lyon, Villeurbanne (France).
IGNITION STUDIES IN A TWO-STAGE CLOSED VESSEL USING VARIOUS IGNITER MATERIALS
D. Grune 29 Aug. 1987 24 p Presented at the Innenballistische Leistungssteigerung von Rohrwaffen Symp., Swisstal-Heimerzheim, Fed. Rep. of Ger., 11-13 Nov. '85; Deut.-Britischer Erfahrungsaustausch uber Innenballistik von Rohrwaffen, Nuremburg, Fed. Rep. of Ger., 2-6 Jun. '86
(Contracts BMvg-T/R-760/F-0004/F-1704; BMvg-T/R-760/G-0012/G-1712)
(ISL-CO-231/86; ETN-88-91633) Avail: NTIS HC A03/MF A01

A pressure bomb with two chambers was developed to study the inflammation of solid propellants. The effects of four igniter materials on single base and double base propellants were studied. Pressure-time curves are shown. The results of letting the inflammation products act on a propellant surface are shown. Boron-potassium nitrate has the best adapted pressure curve. Ignition delay time is 100 microsec. The effect of smokes at the greatest possible distance from point of ignition is discussed. ESA

N88-16844# Construcciones Aeronauticas S.A., Madrid (Spain). Div. de Proyectos.
DETERMINATION OF THE MELTING AND DECOMPOSITION POINTS OF DIFFERENT MATERIALS IN AN OXYGEN STREAM [DETERMINACION DE PUNTOS DE FUSION Y TEMPERATURAS DE DESCOMPOSICION EN CORRIENTE DE OXIGENO DE DIVERSOS MATERIALES]
O. Ruiz 11 Nov. 1987 18 p In SPANISH
(Informe-I-158/86; ETN-88-91663) Avail: NTIS HC A03/MF A01

A Perkin-Elmer calorimeter was used to determine the thermal stability of several polyamide based plastic and magnetic materials in an oxygen environment. The temperature interval is 50 to 650 deg C and the temperature gradient is 10 deg/min. The test pressure is 5 bar. The commercial trademark Arlon 1000 and Arlon 1330 as well as the ferrobarite magnetic material specimens show the highest performance. ESA

N88-16845# Science Research Council, Daresbury (England).
APPLICATION OF A SIMPLE ROTATIONAL SPHERICAL GRATING MOUNTING TO HIGH RESOLUTION SOFT X-RAY SPECTROSCOPY
H. A. Padmore Dec. 1986 12 p
(PB87-164836; DL/SCI/P-535E) Avail: NTIS HC E03/MF E03 CSCL 07D

The design of a new class of grazing incidence monochromator system is presented. The design uses a spherical grating in a simple rotation mounting with the non-dispersive focusing being accomplished with a separate focusing mirror. The characteristics of several configurations of the basic design are presented and the overall design procedures are discussed. The design is essentially free of aberrations and the principal degradation in resolution will be caused by tangential slope errors in the diffraction grating. The effect of the slope error on resolution is examined in detail. The design of an entrance slitless monochromator currently under construction is discussed. GRA

N88-16846# Oak Ridge National Lab., Tenn.
HELIUM-ION-INDUCED RELEASE OF HYDROGEN FROM GRAPHITE
R. A. Langley 1987 12 p Presented at the 34th National Vacuum Symposium and Topical Conference, Anaheim, Calif., 2 Nov. 1987
(Contract DE-AC05-84OR-21400)
(DE88-002599; CONF-871125-15-Rev) Avail: NTIS HC A03/MF A01

The ion-induced release of hydrogen from AXF-5Q graphite was studied for 350-eV helium ions. The hydrogen was implanted into the graphite with a low energy (approx. 200 eV) and to a high fluence. This achieved a thin (approx. 10-nm), saturated near-surface region. The release of hydrogen was measured as a function of helium fluence. A model that includes ion-induced detrapping, retrapping, and surface recombination was used to analyze the experimental data. A value of (1.65 + or - 0.2) x 10 to the minus 16th sq cm was obtained from the detrapping cross section, and a value of (0.5 to 4) x 10 to the minus 14th cm (sup 4)/atoms was obtained for the recombination coefficient. DOE

N88-16847# Argonne National Lab., Ill.
NEW TECHNIQUE FOR ENHANCING HELIUM PRODUCTION IN FERRITIC MATERIALS
L. R. Greenwood, D. G. Graczyk, and D. W. Kneff Oct. 1987 14 p Presented at the 3rd International Conference on Fusion Reactor Materials, Karlsruhe, Fed. Republic of Germany, 4 Oct. 1987 Prepared in cooperation with Rockwell International Corp., Canoga Park, Calif.
(Contract W-31-109-eng-38)
(DE88-003048; CONF-871036-23) Avail: NTIS HC A03/MF A01

Analyses of iron samples irradiated up to 10 to the 27th n/sq m in HFIR found more helium than was expected from fast neutron reactions at high neutron fluences. The helium excess increases systematically with neutron exposure, suggesting a transmutation-driven process. The extra helium may be produced in two different ways, either by fast neutron reactions on the transmuted isotopes of iron or by a thermal neutron reaction with the radioactive isotope Fe-55. Radiometric and mass spectrometric measurements of the iron isotopes composing the irradiated samples have been used to determine limits on the cross sections for each process. Either of these processes can be used to enhance helium production in ferritic materials during irradiations in mixed-spectrum reactors by isotopically enriching the samples. Further work is needed to clarify the reaction mechanisms and helium production cross sections. Our measurements determined the thermal neutron total absorption cross section of Fe-55 to be 13.2 + or - 2.1 barns. DOE

N88-16848# Argonne National Lab., Ill.
BISTABLE CELLULAR FLAMES
A. Bayliss, B. Matkowsky, and M. Minkoff 1987 8 p Presented at the Symposium in Honor of C. C. Lin, Cambridge, Mass., 22 Jun. 1987 Prepared in cooperation with Northwestern Univ., Evanston, Ill.
(Contract W-31-109-eng-38)
(DE88-003074; CONF-8706236-1) Avail: NTIS HC A02/MF A01

The problem of a flame stabilized by a point source of fuel in two dimensions is considered. The diffusional thermal model is employed which consists of a reaction, diffusion, convection system of equations for the temperature and concentration of the limiting component of the reaction. The effect that a given fluid field has on the transport of temperature and concentration is considered, while changes in the underlying flow, due to thermal expansion, are not taken into account. The given fluid velocity field corresponds to a point source of fuel of strength 2kappa. In addition to kappa, the parameters of the problem are the non-dimensional activation energy N, the ratio sigma of the unburned temperature T(sub kappa) to the burned temperature T(sub b), and the Lewis number L which is the ratio of thermal conductivity to reactant diffusivity. The previous analysis employing kappa as a bifurcation parameter,

is a local analysis valid only in the neighborhood of kappa(sub c). This analysis is extended into the more fully nonlinear regime. The numerical results show that as kappa increases from kappa (sub c) the system exhibits a multistable behavior with at least two distinct stable, steady cellular solutions coexisting for the same parameter values. Each such stable solution has its own domain of attraction, so that the resultant steady solution depends on the initial conditions employed. DOE

N88-16849# Wisconsin Univ., Madison. Dept. of Mechanical Engineering.
THE EFFECTS OF FUEL COMPOSITION ON IGNITION DELAY IN HOMOGENEOUS CHARGE AND DIRECT INJECTION COMPRESSION IGNITION ENGINES
D. E. Foster, P. M. Dimpelfeld, D. L. Boggs, R. E. Bair, and G. L. Borman Nov. 1987 135 p
(Contract DE-AC05-84OR-21400)
(DE88-003691; ORNL/Sub-84-89677/1) Avail: NTIS HC A07/MF A01

This report describes the work done at the University of Wisconsin-Madison in two experimental programs. In one program comparisons were made between comprehensive chemical kinetic mechanisms and experimental data for a homogeneous charge engine that was operated in either a spark ignited or compression ignited mode. The aim was to make an assessment of our ability to model the combustion of real fuels in I.C. engines. In the second program the effect of fuel composition on diesel engine performance was evaluated. In particular the effect of the chemical composition of the volatile fraction was examined for its effect on ignition properties and emissions of a direct injection diesel engine. Two analytics were prepared for this document. DOE

26 METALLIC MATERIALS

Includes physical, chemical, and mechanical properties of metals, e.g., corrosion; and metallurgy.

N88-16850# Technische Hochschule, Aachen (West Germany). Inst. fuer Eisenhuettenkunde.
STUDY OF THE TEMPERATURE DEPENDENCE OF THE MECHANICAL CHARACTERISTICS OF THE STEELS GX 5 CrNI 13 4 AND GGG 40 IN TENSILE AND BENDING TESTS
G. Kopfer 1987 81 p
(Contract DE-AC05-84OR-21400)
(DE88-001469; ORNL-tr-87/24) Avail: NTIS HC A05/MF A01

This report addresses the results of the study of the temperature dependence of the mechanical characteristics of two cast materials. Diagrams show the yield point and the tensile strength of the steel GX 5 CrNi 13 4 - as determined from the bending test. For the material GGG 40 we tested the yield point and the tensile strength in unnotched tensile specimens and also the yield point and strength in bending tests with differently notched notched-bar impact bend test specimens as a function of temperature. The steel GX 4 CrNi 13 4 exhibits very good toughness to temperatures of -196 C without any indication of a drop, whereas the GGG 40 casting exhibits a sharp drop in toughness between -130 and -175 C. This embrittlement is virtually independent of the notch sharpness, which is also expressed by the shape of the fracture toughness-temperature curve. Only below about -140 C can valid K/sub IC/ values be determined, since above this temperature the sharp increase in toughness makes an exact K/sub IC/ determination impossible. DOE

N88-16851# Cornell Univ., Ithaca, N.Y. Lab. of Atomic and Solid State Physics.
GEOMETRIC STRUCTURE, PSEUDOBAND GAPS, AND SURFACE VIBRATIONAL RESONANCES ON METAL SURFACES
M. Persson, J. A. Stroscio, and W. Ho Aug. 1987 14 p
(Contract N00014-82-K-0576)
(AD-A187001; TR-40) Avail: NTIS HC A03/MF A01 CSCL 07D

It is shown by surface lattice dynamics that a new type of surface vibrational resonance arises in those frequency regions where there is a strong depletion in the bulk phonon density of states. The presence of these pseudo band gaps is due to higher Fourier components in the phonon dispersion relations introduced by the particular coordination of atoms in layers parallel to the surface. A quantitative analysis based on surface lattice dynamics of the recorded electron energy loss spectra of Cu and Ni suggests that the outermost surface interlayer force constant is rather close to the bulk value. This resonance is found to exist throughout the X direction and makes an avoided crossing with a resonance derived from a band gap at the X point. An explanation is given for the disappearance of the divergent van Hove singularities in the projected bulk density of states upon projection on a surface layer. GRA

N88-16852# Army Lab. Command, Watertown, Mass. Material Technology Lab.
CORROSION BEHAVIOR OF HIGH DENSITY TUNGSTEN ALLOYS Final Report
Milton Levy and Frank C. Chang Aug. 1987 16 p
(AD-A187108; MTL-TR-87-37) Avail: NTIS HC A03/MF A01 CSCL 11F

The corrosion behavior of high density tungsten alloys has been examined by electrochemical potentiostatic polarization methods and weight loss measurements in full immersion tests. Electrochemical tests were carried out in aqueous solutions, buffered to pH 4, 9, 12 with and without 0.1M sodium chloride and immersion tests in 5 percent NaCL solution. Pure tungsten and all the alloys studied undergo active-passive transitions and corrosion rates increase with increasing pH. The chloride ion generally increases corrosion rates slightly, but in pH12 solution, the chloride ion inhibits the anodic reaction to some extent. A 97N-2Ni-0.7Fe-0-3Co alloy was found to be the most corrosion resistant in solutions containing chloride ions. The data also suggests that copper as an alloying element accelerates corrosion of tungsten alloys in NaCL solution. Both general dissolution and localized attack at grain boundaries were observed. GRA

N88-16853# Naval Air Development Center, Warminster, Pa. Aircraft and Crew Systems Technology Directorate.
MULTIPURPOSE CORROSION INHIBITORS FOR AEROSPACE MATERIALS IN NAVAL ENVIRONMENTS Final Report
Vinod S. Agarwala 4 Jun. 1987 22 p
(AD-A186728; NADC-87034-60) Avail: NTIS HC A02/MF A01 CSCL 11F

A multidisciplinary approach was taken to solve the complex problem of premature failure of high strength aircraft alloys from the effects of environment. Principles concerning the time dependent macroscopic interfacial processes occuring at fine geometries (defect sites etc.) and responsible for sub-critical crack growth were isolated to envolve new methods for arresting cracking. It has been shown that a synergistically combined chemical system can be formulated which can modify in situ interfacial chemistry of the crack propagation process such that the life of the material is enhanced significantly. Results show crack growth retardation effects on both steels and aluminum alloys when tested for corrosion fatigue and/or stress corrosion cracking in high humidity and saline environment. factor. GRA

N88-16854# Technische Hochschule, Aachen (West Germany). Fakultaet fuer Bergbau, Huettenwesen und Geowissenschaften.
INVESTIGATION OF THE DEFORMATION BEHAVIOR OF THE INTERMETALLIC PHASE (Fe,Ni)Al AT HIGH TEMPERATURES Ph.D. Thesis [UNTERSUCHUNG DES VERFORMUNGSVERHALTENS DER INTERMETALLISCHEN PHASE (FE,NI)AL BEI HOHEN TEMPERATUREN]
Martina Rudy 1986 128 p In GERMAN
(ETN-88-91062) Avail: NTIS HC A07/MF A01

Creep mechanisms in the intermetallic phase (Fe,Ni)Al with ordered atomic distribution, suitable for high temperature applications, were investigated. The deformation tests show a brittle materials behavior at low temperatures, but a ductile behavior in

the range of diffusion-controlled deformation. Two mechanisms are responsible for the creep of the intermetallic phase: deformation in the grain and grain boundary sliding. The creep behavior is determined by diffusion creep at low stresses, and by displacement creep at high stresses. Structural defects accelerate diffusion phenomena. At high temperature, the creep strength significantly decreases for deviations from the stochiometric composition. The investigated phases are comparable with the usual high temperature superalloys with respect to strength properties and corrosion resistance. ESA

N88-16855# Technische Hochschule, Aachen (West Germany). Fakultaet fuer Maschinenwesen.
EFFECTS OF A REGENERATING HEAT TREATMENT ON THE CREEP BEHAVIOR AND THE LIFETIME DURING CREEP TEST LOADING Ph.D. Thesis [AUSWIRKUNG EINER REGENERIERENDEN WAERMEBEHANDLUNG AUF DAS KRIECHVERHALTEN UND DIE LEBENSDAUER BEI ZEITSTANDBEANSPRUCHUNG]
Klaus A. Jaeger 1985 172 p In GERMAN
(ETN-88-91063) Avail: NTIS HC A08/MF A01

The modeling of void shrinkage during a regenerating heat treatment of creep-loaded materials, as well as the regeneration capability of austenitic steels were studied. Crack initiation and propagation are treated. A model for grain-boundary void shrinkage by diffusion as well as by backcreeping due to an internal backstress and a surface tension induced stress field was developed. The effect of an additional external hydrostatic pressure was taken into account. The effects of an intermediate annealing after creep loading on the further creep behavior and the residual lifetime of the austenitic steels X8GNiMoNb1616 and X6CrNi1811 were determined. Damage occurring during creep tests and regeneration effects were demonstrated by metallographic and density measurements, and by raster electron microscopy. ESA

N88-16856# Karlsruhe Univ. (West Germany). Fakultaet fuer Maschinenbau.
FRACTURE-MECHANICAL STATISTICS AND FRACTOGRAPHIC INVESTIGATIONS ON THE STEEL 20 MnMoNI 55 IN THE DUCTILE-BRITTLE TRANSITION DOMAIN Ph.D. Thesis [BRUCHMECHANISCHE, STATISTISCHE UND FRAKTOGRAPHISCHE UNTERSUCHUNGEN AM STAHL 20 MNMONI 55 IM DUKTIL-SPROEDEN UEBERGANGSBEREICH]
Werner Ehl 1987 93 p In GERMAN
(ETN-88-91064) Avail: NTIS HC A05/MF A01

The influence of the component and crack geometry on the fracture-mechanical characteristics of ferritic steels and on their scattering, was investigated using steel 20MnMoNi55. The present status of statistical models is reviewed. The origin of fracture was determined for almost all test specimens on the brittle fracture surface. A connection between J-integral and fissure of the brittle fracture surface was found. The initiation of the brittle fracture was described by the weakest-link model: the proceeding stable crack growth can be described by a extended model. The weakest-link model does not predict the scattering among the specimens. Results with bend specimen with semi-elliptical surface crack indicate that the weakest-link model can also be used for this crack geometry. ESA

N88-16857# Fraunhofer-Inst. fuer Zerstoerungsfreie Pruefverfahren, Saarbruecken (West Germany).
NONDESTRUCTIVE MAGNETIC TESTING OF LASER HARDENING PARAMETERS (HARDENING DEPTH, HARDNESS PROFILE, RETAINED AUSTENITE) Final Report, Dec. 1985
Rolf Kern and Werner Theiner Bundesministerium fuer Forschung und Technologie 1986 70 p In GERMAN; ENGLISH summary Presented at VDI-TZ Conference, Duesseldorf, Fed. Republic of Germany, 21 Apr. 1986
(Contract BMFT-13-N-5303/9)
(ETN-88-91070) Avail: NTIS HC A04/MF A01

Because of the increasing commercial use of high power lasers for surface annealing treatments, a nondestructive test to improve the production quality and reliability was developed to determine the fundamental hardening parameters hardness, hardening depth, and retained austenite. It is shown that two micromagnetic methods, magnetic Barkhausen noise and incremental permeability, and derived quantities, e.g., the maximum amplitude of the Barkhausen noise or the coercivity, are appropriate to determine the above material parameters. ESA

N88-16858# Siemens A.G., Erlangen (West Germany). Forschungslab.
POWDER METALLURGICAL PREPARATION OF A15 SUPERCONDUCTORS Final Report, Jun. 1985
Manfred Wilhelm, Karl Wohlleben, Engelbert Springer, Klaus Mrowiec, Wilfried Schaper, and Joachim Wecker (Goettingen Univ., West Germany) Bonn, Fed. Republic of Germany BMFT Aug. 1985 127 p In GERMAN; ENGLISH summary Original language document was announced as N88-12392
(Contract BMFT-13-N-5294/6)
(ETN-88-91072) Avail: NTIS HC A07/MF A01

Powder-metallurgical preparations of Cu-Nb3Sn micro composite superconductors were investigated to economize the manufacture of the conductors and to improve their mechanical and electrical properties. Conditions during high temperature extrusion, also considering cold working, were optimized by adding Al or Ti as reducing agent. Current densities much greater than 10,000 A/sqcm at 15 T are obtained by applying coarse-grained Nb powder and incorporating small quantities of Ta or Ti. The current carrying behavior of the conductors was investigated with regard to the degree of mechanical deformation, the technique of cold work, and the conditions during heat treatment. Wires containing an internal tin source, and bundled assemblies for high currents were manufactured. With the design of the conductors and the deformation technique described, it is possible to produce very long wires. ESA

N88-16859# Construcciones Aeronauticas S.A., Madrid (Spain).
LOW FREQUENCY EDDY CURRENT DETECTION AND EVALUATION OF CORROSION IN AIRCRAFT SKINS
J. M. Bernardo, B. Sainz, C. Valdecantos, and V. Cortes 1987 7 p Presented at the 4th European Conference on Nondestructive Testing, London, United Kingdom, 13-18 Sep. 1987
(ETN-88-91664) Avail: NTIS HC A02/MF A01

Applicability of low frequency eddy current test for the detection and evaluation of corrosion on aircraft fuselage skins was evaluated with two different commercially available eddy current instruments, one with needle indicator and the other with flying dot CRT display. Experiments carried out on laboratory samples 1.8 mm thick chemically milled to simulated corrosion, show that results are quite good when only 1 sheet is involved and frequencies between 4 and 10 KHz are applied. But when corrosion is under doubler areas the separation between skin and doubler is a major variable in quantitative measurements. ESA

N88-16860# Oak Ridge National Lab., Tenn.
MICROSTRUCTURAL MODIFICATION DURING LASER WELDING
S. A. David and J. M. Vitek 1988 18 p Presented at the Indo/US Advanced Study Workshop, Hyderabad, India, 15 Jan. 1988
(Contract DE-AC05-84OR-21400)
(DE88-002344; CONF-880137-1) Avail: NTIS HC A03/MF A01

An investigation was carried out to determine the effect of rapid solidification on the weld metal microstructure of austenitic stainless steels and its implication on the ferrite constitution diagram. A wide variety of stainless steels were laser welded at different welding speeds and laser power levels. The results indicate that both weld pool cooling rate and the post solidification solid state cooling rates have a profound effect on the microstructures. For the steels investigated the microstructures ranged from duplex austenite (gamma) + ferrite (delta) to fully austenitic or fully ferritic. These microstructures were found to be sensitive to both cooling rates and composition. The observed results are rationalized based on rapid solidification theory. Cooling rate effects were incorporated into the ferrite constitution diagram

to reflect the observed microstructural changes at high cooling rates of the weld metal. DOE

N88-16861# Argonne National Lab., Ill.
LONG-TERM-AGING EMBRITTLEMENT OF CAST DUPLEX STAINLESS STEELS: MECHANISM AND KINETICS
H. M. Chung and O. K. Chopra Jul. 1987 32 p Presented at the Symposium on Properties of Stainless Steels in Elevated Temperature Service, Boston, Mass., 13 Dec. 1987
(Contract W-31-109-eng-38)
(DE88-002929; CONF-871232-1) Avail: NTIS HC A03/MF A01

Microstructural characteristics of long-term-aged cast duplex stainless steel specimens including one from a BWR, were investigated by SEM, TEM, SANS, and APFIM techniques. Three precipitate phases, Cr-rich alpha particles and the Ni- and Si-rich G phase, and gamma sub 2 austenite, have been identified in the ferrite matrix of the aged specimens. For CF-8 grade materials, M23C6 carbides were identified on the austenite-ferrite boundaries as well as in the ferrite matrix for aging at greater than or equal to 450 C. The Si, C, and Mo contents influenced the kinetics of the G-phase precipitation. However, TEM, and APFIM analyses indicate that the embrittlement during aging at less than or equal to 400 C is primarily associated with Fe and Cr segregation in ferrite by spinodal decomposition. For extended aging, e.g., 6 to 8 years at 350 to 400 C, large platelike alpha particles formed by nucleation and growth from the structure produced by the spinodal decomposition. The Cr content appears to either promote the platelike alpha particles (high Cr content) or to suppress the alpha particles in favor of alpha particle precipitation (low Cr). DOE

N88-16862# Japan Atomic Energy Research Inst., Tokyo.
FATIGUE AND UNIAXIAL DEFORMATION BEHAVIOR OF HASTELLOY XR AT ELEVATED TEMPERATURES
Kenji Kanazawa, Koji Yamaguchi, Satoshi Nishijima, Isoharu Nishiguchi, Yasushi Muto, and Hirokazu Tsuji Aug. 1987 46 p
(DE88-751058; JAERI-M-87-114) Avail: NTIS (US Sales Only) HC A03/MF A01

Fully reversed continuous cycling tests and tensile tests were conducted on Hastelloy XR at temperatures ranging from 600 to 950 C in air. Fatigue life of Hastelloy XR depends on temperature. A series of SEM observation revealed that transgranular fracture with evident striation formation was dominant at temperatures below 800 deg C, while intergranular cracking was found above 900 C. These results suggest that creep mechanism takes place in the fatigue behavior of this alloy above 900 deg C. Numerical analyses of deformation behavior during fatigue and tensile tests were conducted to interpret the experimental results. Conventional elastic-creep constitutive equations gave a good prediction of this deformation process. DOE

N88-16863# California Univ., Berkeley. Lawrence Berkeley Lab.
INFLUENCE OF POST-ANNEAL COOLING TREATMENTS ON SUPPRESSION OF CRYOGENIC INTERGRANULAR FRACTURE IN EXPERIMENTAL Ni-FREE HIGH-Mn AUSTENITIC STEELS
M. Strum and J. W. Morris, Jr. Aug. 1987 20 p Presented at the Conference on Advances in Cryogenic Engineering, St. Charles, Ill., 14 Jun. 1987
(Contract DE-AC03-76SF-00098)
(DE88-002766; LBL-23853; CONF-8706125-21) Avail: NTIS HC A03/MF A01

The influence of thermal history on the grain boundary chemistries and cryogenic mechanical properties of two high-Mn austenitic steels are examined. While high-Mn alloys with excellent toughness at 4K have been developed, the Ni-free high-Mn alloys are susceptible to cryogenic intergranular embrittlement. Both the source of this embrittlement and the conditions necessary for its control have remained poorly understood. In quaternary Fe-30Mn-5Cr-0.16N and Fe-30Mn-5Cr-0.22N alloys the cryogenic toughness is strongly dependent on cooling rate. The 77K Charpy impact toughness of Fe-30Mn-5Cr-0.16N increases with decreasing cooling rate from 41 J after a brine-quench to 183 J after air-cooling. The influence of post-quench isothermal tempering treatments between 723 and 1023K on the impact toughness is also measured. The grain boundary chemistries of brine-quenched and air-cooled samples were examined by Auger electron spectroscopy. No grain boundary segregation of Mn is observed but both N and slight Cr enrichments are present. While no segregation of common embrittling species occurs, boron segregates to the grain boundaries during slow cooling. DOE

N88-16864# Argonne National Lab., Ill.
LONG-TERM AGING OF CAST STAINLESS STEELS: MECHANISMS AND RESULTING PROPERTIES
O. K. Chopra and H. M. Chung Sep. 1987 33 p Presented at the 15th Water Reactor Safety Information Meeting, Gaithersburg, Md., 26 Oct. 1987
(Contract W-31-109-eng-38)
(DE88-002888; CONF-8710111-14) Avail: NTIS HC A03/MF A01

Mechanical property data are presented from Charpy-impact, tensile, and J-R curve tests for several heats of cast stainless steel aged up to 10,000 h at 450, 400, 350, 320, and 290 C. The results indicate that thermal aging increases the tensile strength and decreases the impact energy, J/sub IC/ and tearing modulus of the steels. Also, the ductile-to-brittle transition curve shifts to higher temperatures. The low-carbon CF-3 steels were the most resistant and the molybdenum-containing high-carbon CF-8M steels were the most susceptible to low-temperature embrittlement. The influence of nitrogen content and distribution of ferrite on loss of toughness are discussed. Data also indicate that existing correlations do not accurately represent the embrittlement behavior over the temperature range 280 to 450 C, i.e., extrapolation of high-temperature data to reactor temperatures may not be valid for some compositions of cast stainless steels. DOE

N88-16865# Argonne National Lab., Ill.
CHARACTERIZATION OF DUPLEX STAINLESS STEEL BY TEM (TRANSMISSION ELECTRON MICROSCOPY), SANS (SMALL-ANGLE NEUTRON SCATTERING) AND APFIM (ATOM-PROBE FIELD ION MICROSCOPY) TECHNIQUES
H. M. Chung and O. K. Chopra Jun. 1987 55 p Presented at the Symposium on Characterization of Advanced Materials, Monterey, Calif., 27 Jul. 1987
(Contract W-31-109-eng-38)
(DE88-002916; CONF-8707132-1) Avail: NTIS HC A04/MF A01

Results are presented of complementary characterization of aged duplex stainless steels by advanced metallographic techniques, including transmission and high-voltage electron microscopies; small-angle neutron scattering; and atom-probe field ion microscopy. On the basis of the characterization, the mechanisms of aging embrittlement have been shown to be associated with the precipitation of Ni- and Si-rich G phase and Cr-rich alpha particles in the ferrite, and M23C6 carbides on the austenite-ferrite phase boundaries. DOE

N88-16866# Argonne National Lab., Ill.
AGING DEGRADATION OF CAST STAINLESS STEELS: EFFECTS ON MECHANICAL PROPERTIES
O. K. Chopra and H. M. Chung Jun. 1987 34 p Presented at the 3rd International Symposium on Environmental Degradation of Materials in Nuclear Power Systems: Water Reactors, Traverse City, Mich., 30 Aug. 1987
(Contract W-31-109-eng-38)
(DE88-003053; CONF-870839-8) Avail: NTIS HC A03/MF A01

A program is being conducted to investigate the significance of in-service embrittlement of cast duplex stainless steels under light-water operating conditions. Mechanical property data are presented from Charpy-impact, tensile, and J-R curve tests for several heats of cast stainless steel aged up to 10,000 h at 450, 400, 350, 320, and 290 C. The results indicate that thermal aging increases the tensile strength and decreases the impact energy, J/sub IC/, and tearing modulus of the steels. Also, the ductile-to-brittle transition curve shifts to higher temperatures. The fracture toughness results are consistent with the Charpy-impact

data, i.e., the relative reduction in J/sub IC/ is similar to the relative decrease in impact energy. The ferrite content and concentration of C in the steel have a strong effect on the overall process of low-temperature embrittlement. The low-carbon CF-3 steels are the most resistant and Mo-containing CF-8M steels are most susceptible to embrittlement. Weakening of the ferrite/austenite phase boundaries by carbide precipitates has a significant effect on the kinetics and extent of embrittlement of the high-carbon CF-8 and CF-8M steels, particularly after aging at temperatures greater than or equal to 400 C. The influence of N content and distribution of ferrite on loss of toughness are discussed. The data also indicate that existing correlations do not accurately represent the embrittlement behavior over the temperature range 280 to 450 C, i.e., extrapolation of high-temperature data to reactor temperatures may not be valid for some compositions of cast stainless steel. DOE

N88-16867 Illinois Univ. at Urbana-Champaign, Savoy.
HYDROGEN IN NIOBIUM-TANTALUM SUPERLATTICES Ph.D. Thesis
Paul Frank Miceli 1987 187 p
Avail: Univ. Microfilms Order No. DA8721714

Hydrogen was dissolved in Nb/Ta superlattices for which the structural and thermodynamic properties of this new H-metal system were studied, in situ, by X-ray diffraction. It was found that H induces a strain modulation exhibiting a Curie-Weiss type temperature dependence, thus, providing a first example of a strained layer superlattice which can be strained after the growth of the structure. In addition, a lattice-gas lattice-liquid phase transition was observed where critical fluctuations exist only for wavelengths longer than the supperlattice periodicity. The absence of short wavelength fluctuations prohibit phase separation and constitutes a novel manifestation of a coherent phase transition. A mean field lattice gas model is presented, which, combined with X-ray data from the superlattice satellites, provides insight to the fundamental properties of a lattice gas in the presence of modulated interactions. Motivated by these experiments, a generalized theoretical framework from which to view coherent phase transitions is discussed. Dissert. Abstr.

27 NONMETALLIC MATERIALS

Includes physical, chemical, and mechanical properties of plastics, elastomers, lubricants, polymers, textiles, adhesives, and ceramic materials.

For composite materials see *24 Composite Materials*.

N88-16868*# General Motors Corp., Indianapolis, Ind. Gas Turbine Div.
NONDESTRUCTIVE EVALUATION OF STRUCTURAL CERAMICS BY PHOTOACOUSTIC MICROSCOPY Final Report
Pramod K. Khandelwal Jun. 1987 110 p
(Contract NAS3-24390)
(NASA-CR-180858; NAS 1.26:180858; EDR-12815) Avail: NTIS HC A06/MF A01 CSCL 11B

A photoacoustic microscopy (PAM) digital imaging system was developed and utilized to characterize silicon nitride material at the various stages of the ceramic fabrication process. Correlation studies revealed that photoacoustic microscopy detected failure initiating defects in substantially more specimens than microradiography and ultrasonic techniques. Photoacoustic microscopy detected 10 to 100 micron size surface and subsurface pores and inclusions, respectively, up to 80 microns below the interrogating surface in machined sintered silicon nitride. Microradiography detected 50 micron diameter fracture controlling pores and inclusions. Subsurface holes were detected up to a depth of 570 microns and 1.00 mm in sintered silicon nitride and silicon carbide, respectively. Seeded voids of 20 to 30 micron diameters at the surface and 50 microns below the interrogating surface were detected by photoacoustic microscopy and microradiography with 1 percent X-ray thickness sensitivity. Tight surface cracks of 96 micron length x 48 micron depth were detected by photoacoustic microscopy. PAM volatilized and removed material in the green state which resulted in linear shallow microcracks after sintering. This significantly limits the use of PAM as an in-process NDE technique. M.G.

N88-16869# North Carolina Agricultural and Technical State Univ., Greensboro. Dept. of Electrical Engineering.
FABRICATION AND PACKAGING OF DISCONTINUOUS MIM (METAL-INSULATOR-METAL) FILM ARRAYS FOR EFFICIENT MM WAVE AND IR DETECTION AND MIXING Final Report, 5 Sep. 1983 - 12 Aug. 1987
Yu Chung Oct. 1987 90 p
(Contract DAAG29-83-G-0114)
(AD-A186809; ARO-20731.4-EL-H) Avail: NTIS HC A05/MF A01 CSCL 09A

Sputtering deposition of discontinuous Ni islands on a glass plate automatically produces a planar MOM diode array structure that will be mechanically stable when electrical leads are silver soldered to any two points of the coated plate. However, the efficiency in radiation reception and detection is totally controlled by the geometry of the diode array or the deposition process, which is mostly random due to deposition at very low sputtering powers. Such an array structure also has very poor antenna properties. Diode responsivity is found to be significantly improved by the incorporation of an etched-tip tungsten whisker, serving both as a long wire antenna for radiation reception and as a sharp tip electrical contact that concentrates the incident field and directs it to a selected nickel island group. This improvement in diode responsivity is offset by degradation in diode stability similar to that experienced by the MOM point contact diode, but to a lesser extent. The distinction between these two structures lies in the fact that the whisker serves mainly as an electrical contact in the discontinuous film diode, while it serves as the other electrode, sandwiching an ultrathin oxide layer, in the point contact vision. Stability can again be improved by deliberate hooking of an optimally etched tip without blunting. Some blunting is acceptable in the film diode at the expense of reduced diode responsivity. GRA

N88-16870# Army Lab. Command, Watertown, Mass. Material Technology Lab.
WIRE-CUT ELECTRICAL DISCHARGE MACHINABILITY OF CERAMICS Final Report
William S. Ricci, Holly A. Skeele, and William R. Blumenthal Sep. 1987 29 p
(AD-A186989; MTL-TR-87-52) Avail: NTIS HC A03/MF A01 CSCL 11B

The wire-cut electrical discharge machinability of four ceramics was evaluated. Titanium diboride and silicon carbide workpieces were successfully cut in the monolithic state. Boron carbide could only be cut when a metallic sandwich structure was placed around the workpiece. Silicon nitride could not be successfully cut. Mechanisms of material removal as well as a minimum level of workpiece electrical conductance necessary for EDM are proposed. Characterization of the surface damage resulting from electrical discharge machining is presented. Recast, partially melted, and heat affected zones are identified. The effects of parametric processing variations on surface integrity are discussed. Flexure strength and residual stress data are compared for EDM cut and diamond ground surfaces in titanium diboride. Certain limitations are proposed for the EDM fabrication of ceramic components where surface defects are strength limiting. GRA

N88-16871# Royal Aircraft Establishment, Farnborough (England).
EFFECTS OF ADDITIVES ON FIRE PROPERTIES OF POLYETHYLENE
A. J. Christopher Jul. 1987 36 p
(AD-A187064; RAE-TM-MATH-STR-1096; BR103781) Avail: NTIS HC A03/MF A01 CSCL 11B

Low-density polyethylene, with and without an antimony-bromine synergistic fire retardant or aluminum hydroxide, was subjected to standard fire tests and to experiments which determined the smoke

and harmful fumes emitted on overheating. Both additives improved most fire properties but the fire retardant increased the smoke generated by intense radiant heat. The onset of smoke, flammable gas, carbon monoxide and acids was generally delayed by the additives. The total amounts and maximum values of these volatiles were lessened. Sample weight and form effect the results from these experiments. Observations during heating show that the additives reduce spreading of the melt, thus reducing the surface area available for oxidation. This Memorandum has been submitted to the journal Fire and Materials. GRA

N88-16872# University of Southern Mississippi, Hattiesburg. Dept. of Polymer Science.
A 13C AND 15N SOLID STATE NMR CHARACTERIZATION OF ARAMID-CONTAINING NYLON-6 POLYMERS SYNTHESIZED BY IN SITU POLYMERIZATION OF CAPROLACTAM WITH BENZOYL CAPROLACTAM DERIVATIVES
Douglas G. Powell, Allison M. Sikes, and Lon J. Mathias 1 Dec. 1987 12 p
(Contract N00014-86-K-0659)
(AD-A187067; TR-7) Avail: NTIS HC A03/MF A01 CSCL 11B

Copolyamides were prepared by in situ polymerization from p-Aminobenzoylcaprolactam and caprolactam systems initiated with sodium hydride. The microstructure of the copolymers as determined by 13C solution NMR varied from alternating to blocks of aliphatic and/or aromatic units depending on the reaction conditions and the ratio of th comonomers. The solid-state CP/MAS 13C NMR were consistent with solution studies. Detailed interpretation was difficult due to large linewidth and number resonances. Natural abundance CP/MAS 15N spectra were found to be less complicated. Based on these results an 15N studies with model amides, 15N CP/MAS was shown to be a useful technique for probing copolymer composition and microstructure. GRA

N88-16873# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ANALYSIS OF THE DECOMPOSITION OF TRANSPARENT POLYMER MATERIALS (BLOCKS) UNDER THE ACTION OF LASER BEAMS IN FREE GENERATION MODE
M. A. Sultanov, B. N. Narzullayev, and V. Urunov 26 Aug. 1987 17 p Transl. into ENGLISH from Doklady Akademii Nauk Tadzhikskoy SSR (USSR), v. 13, no. 3, 1970 p 12-16
(AD-A187090; FTD-ID(RS)T-0646-87) Avail: NTIS HC A03/MF A01 CSCL 11B

The mechanism of decomposition of transparent blocks was investigated in terms of the power of generation, number of pulses, focal length of the lens etc., in ruby and neodymium lasers both in conditions of free generation and large pulses. However, the mechanism of the decomposition of the materials demonstrated under the action of laser beams by the different authors is explained differently. There is no unity of opinion on the mechanism of decomposition of transparent materials (blocks) under the effect of coherent emission. Some experimental results, on the effect of supersonic plasma jets on different polymeric materials, showed that in the mechanism of decomposition the dominant role is played by thermal effects. Therefore, it was of interest to check this assumption in the case of the effect of laser emission on polymeric materials. For this purpose two glass-neodymium lasers were assembled. Changes were studied by means of the fracturing of the blocks of polymethyl acrylate - PMMA, quartz, glass and polystyrene with relation to focal length of lens, and generating power of the laser beam on the material. Decomposition was studied both microscopically and by photograph. GRA

N88-16874# Salford Univ. (England). Dept of Chemistry.
LITHIUM/POLYMER ELECTROLYTE INTERFACIAL INSTABILITY
K. A. Murugesamoorthi and John R. Owen 26 Oct. 1987 22 p
(Contract N00014-85-G-0185)
(AD-A187164; TR-1) Avail: NTIS HC A03/MF A01 CSCL 07D

The stability of evaporated lithium with polyethylene oxide (PEO), polypropylene oxide (PPO) and oxyethlylene-oxymethylene copolymer, doped with lithium perchlorate, in ultra thin film cells, was studied by impedance spectroscopy at room temperature. The formation and growth of a passivating film at the lithium/PEO interface has been observed, under open circuit conditions. The thickness of the passivating layer was estimated by assuming the dielectric constant of the interfacial product. Compared to PEO, a more extensive interfacial reaction was observed in the case of PPO. A very fast interfacial reaction was observed between lithium and amorphous copolymer. GRA

N88-16875# Ultramet, Pacoima, Calif.
OXIDATION RESISTANCE OF CVD COATINGS Final Report, Sep. 1984 - Aug. 1986
John T. Harding, Vince Fry, R. H. Tuffias, and R. B. Kaplan Feb. 1987 27 p
(Contract F04611-84-C-0043; AF Proj. 5730)
(AD-A178337; AFRPL-TR-86-099) Avail: NTIS HC A03/MF A01 CSCL 11C

Chemical vapor deposition (CVD) of Ir, Pt, Rh, ZrO2, and HfO2 was investigated for the purpose of protecting Re, Mo, Hi, Nb, Cu, and carbon composites from oxidation at temperatures from 1000 to 2000 C. Iridium has proved easiest to deposit. Earlier difficulties with codeposition of carbonaceous residues were overcome, and dense, adherent, coatings which stop oxidation of the substrate are reliably produced. The iridium deposition process developed here was applied in the fabrication of several rhenium thrusters. Some of these were test fired by Aerojet Techsystems using MMH/NTO propellant. One chamber has completed over 8 hours of operation including 3600 starts and 4 hours burn time between 2150 and 2200 C at a mixed ratio of 1.65. No measurable change in throat diameter was observed and the mass loss was only 0.9 g or 1.4 percent. Author

N88-16876# Oak Ridge National Lab., Tenn.
NEUTRON- AND X-RAY-SMALL ANGLE SCATTERING WITH Fe-BASE METALLIC GLASSES
P. Lamparter, S. Steeb, D. M. Kroeger, and S. Spooner 1987 10 p Presented at the 6th International Conference on Rapidly Quenched Metals, Montreal, Quebec, 3 Aug. 1987 Prepared in cooperation with Max-Planck-Inst. fuer Metallforschung, Stuttgart, Fed. Republic of Germany
(Contract DE-AC05-84OR-21400)
(DE88-002538; CONF-870893-5) Avail: NTIS HC A02/MF A01

Small angle neutron, as well as X-ray scattering experiments have been performed with the metallic glasses Fe80B20 and Fe80B20Si2C2. The amorphous ribbons were investigated in the as-quenched state and after relaxation anneals well below the crystallization temperatures where the materials undergo a ductile-brittle transition. The observed scattering effects reveal small structural inhomogeneities as well as extended fluctuations on a scale up to at least some thousand A, which both can be identified as concentration fluctuations. Inner surfaces or one-dimensional regions are suggested as sites for segregation of the metalloid atoms and impurities as well as sites favoring nucleation of crystallites. These processes, already taking place during the solidification, are enhanced by low temperature anneals, thus causing embrittlement of the amorphous material. DOE

N88-16877*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
CORRELATIONS OF NORBORNENYL CROSSLINKED POLYIMIDE RESIN STRUCTURES WITH RESIN THERMO-OXIDATIVE STABILITY, RESIN GLASS TRANSITION TEMPERATURE AND COMPOSITE INITIAL MECHANICAL PROPERTIES
William B. Alston 1988 5 p Presented at the Multidisciplinary Workshop on Chemistry and Properties of High Performance Composites, Jackson, Wyo., 28-31 Mar. 1988; sponsored by the American Chemical Society
(NASA-TM-100791; E-3966; NAS 1.15:100791;

AVSCOM-TR-88-C-004) Avail: NTIS HC A02/MF A01 CSCL 11B

PMR (polymerization of monomeric reactants) methodology was used to prepare 70 different polyimide oligomeric resins and 30 different unidirectional graphite fiber/polyimide composites. Monomeric composition as well as chain length between sites of crosslinks were varied to examine their effects on resin thermo-oxidative stability and glass transition temperature (Tg) of the cured/postcured resins. A linear correlation of decreasing 316 C resin weight loss/surface area versus (1) decreasing aliphatic content, or (2) increasing benzylic/aliphatic content stoichiometry ratio over a wide range of resin compositions was observed. An almost linear correlation of Tg versus molecular distance between the crosslinks was also observed. An attempt was made to correlate Tg with initial composite mechanical properties (flexural strength and interlaminar shear strength). However, the scatter in mechanical strength data prevented obtaining a clear correlation. Instead, only a range of composite mechanical properties was obtained at 25, 288, and 316 C. Perhaps more importantly, what did become apparent during the correlation study was (1) the PMR methodology could be used to prepare composites from resins containing a wide variety of monomer modifications, (2) that these composites almost invariably provided satisfactory initial mechanical properties as long as the resins formulated exhibited satisfactory processing flow, and (3) that PMR resins exhibited predictable rates of 316 C weight loss/surface area based on their benzylic/aliphatic stoichiometery ratio. Author

N88-16878*# Virginia Polytechnic Inst. and State Univ., Blacksburg. Center for Adhesion Science.

FACTORS AFFECTING THE STICKING OF INSECTS ON MODIFIED AIRCRAFT WINGS Annual Report, 1 Jan. - 31 Jul. 1987

O. Yi, M. R. Chitsaz-Z, N. S. Eiss, and J. P. Wightman 8 Feb. 1988 31 p

(Grant NAG1-300)

(NASA-CR-182451; NAS 1.26:182451; Rept-102; CAS/CHEM/ME-18-87) Avail: NTIS HC A03/MF A01 CSCL 11B

Previous work showed that the total number of insects sticking to an aluminum surface was reduced by coating the aluminum surface with elastomers. Due to a large number of possible experimental errors, no correlation between the modulus of elasticity, the elastomer, and the total number of insects sticking to a given elastomer was obtained. One of the errors assumed to be introduced during the road test is a variable insect flux so the number of insects striking one surface might be different from that striking another sample. To eliminate this source of error, the road test used to collect insects was simulated in a laboratory by development of an insect impacting technique using a pipe and high pressure compressed air. The insects are accelerated by a compressed air gun to high velocities and are then impacted with a stationary target on which the sample is mounted. The velocity of an object exiting from the pipe was determined and further improvement of the technique was achieved to obtain a uniform air velocity distribution. Author

N88-16879*# College of William and Mary, Williamsburg, Va. Dept. of Chemistry.

SPACE ENVIRONMENTAL EFFECTS ON POLYMERIC MATERIALS Final Technical Report, 1 May 1986 - 31 May 1987

Richard L. Kiefer and Robert A. Orwoll 1987 31 p

(Grant NAG1-678)

(NASA-CR-182454; NAS 1.26:182454) Avail: NTIS HC A03/MF A01 CSCL 11B

Polymeric materials that may be exposed on spacecraft to the hostile environment beyond Earth's atmosphere were subjected to atomic oxygen, electron bombardment, and ultraviolet radiation in terrestrial experiments. Evidence is presented for the utility of an inexpensive asher for determining the relative susceptibility of organic polymers to atomic oxygen. Kapton, Ultem, P1700 polysulfone, and m-CBB/BIS-A (a specially formulated polymer prepared at NASA Langley) all eroded at high rates, just as was observed in shuttle experiments. Films of Ultem, P1700 polysulfone, and m-CBB/BIS-A were irradiated with 85 keV electrons. The UV/VIS absorbance of Ultem was found to decay with time after irradiation, indicating free radical decay. The tensile properties of Ultem began to change only after it had been exposed to 100 Mrads. The effects of dose rate, temperature, and simultaneous vs. sequential electron and UV irradiation were also studied. Author

N88-16880# Admiralty Research Establishment, Dunfermline (England).

ADHESIVE BOND STRENGTHS ON ALUMINIUM ALLOYS AS A FUNCTION OF SURFACE TOPOGRAPHIES AND THEIR WETTING PROPERTIES

D. A. Moth Mar. 1987 17 p

(ARE-TM(UMM)-87403; BR102092; ETN-88-91512) Copyright Avail: NTIS HC A03/MF A01

It is shown that the strength achieved by an adhesive joint on aluminum alloys depends primarily on the wetting capabilities of the adhesive to the adherent. Poorly prepared surfaces and, in particular, those exhibiting hydroxide surface skins, give poor wetting and low bond strengths. The surface topography itself is insignificant in determining bond strengths. ESA

N88-16881# Institut National des Sciences Appliquees de Lyon, Villeurbanne (France). Lab. des Materiaux Macromoleculaires.

MORPHOLOGY CONTROL AND REINFORCING MECHANISMS USING AN ELASTOMER IN AN EPOXY NETWORK BASED ON DIAMINE MENTHANE Ph.D. Thesis [CONTROLE DE LA MORPHOLOGIE ET MECANISMES DE RENFORCEMENT DUN RESEAU EPOXYDE A BASE DE MENTHANE DIAMINE PAR UN ELASTOMERE]

Serge Jean Pierre Montarnal 1987 206 p In FRENCH; ENGLISH summary

(ISAL-IDI1-87-09; ETN-88-91628) Avail: NTIS HC A10/MF A01

The characterization of an epoxy system based on DGEBA prepolymer and the 1-8 diamino-p-menthane is studied. The low reactivity of the system is due to the sterically hindered amine functions. The presence of quaternary carbon atoms in the amine structure results in a thermic degradation by homolytic cleavage. When the system is modified by the addition of a reactive elastomer such as copolymer of butadiene-acrylonitrile the phase separation observed during the cure is quicker as viscosity is low and the kinetics of polycondensation is slowed down. The influence of temperature and elastomer concentration on the morphology was also studied, indicating that the presence of rubber particles favors the plastic deformation mainly by a shear flow. ESA

N88-16882# Institut National des Sciences Appliquees de Lyon, Villeurbanne (France). Groupe d'Etudes Metallurgie Physique et Physique des Materiaux.

STUDY OF THE MICROMECHANICAL PROPERTIES OF FLUOR GLASSES BASED ON ZrF4 Ph.D. Thesis [ETUDE DES PROPRIETES MICROMECANIQUES DES VERRES FLUORES A BASE DE ZRF4]

Khemissi Abbes 1987 131 p In FRENCH

(ISAL-ITC1-87-03; ETN-88-91631) Avail: NTIS HC A07/MF A01

Experimental results from mechanical spectrometry measurements are used to analyze the dynamic behavior of ZrF4 glasses. A nonelastic deformation model is developed and compared with the experimental results. The results show secondary relaxation phenomena near the glass transition point, and identify two types of atomic bonds, one weak and ionic, the other strong and covalent. The proposed nonelastic deformation model agrees well with experimental data. ESA

N88-16883# Institut National des Sciences Appliquees de Lyon, Villeurbanne (France).
STUDY OF MOLECULAR MOBILITY OF NONCRYSTALINE POLYMER ALLOYS OF DIFFERENT COMPATIBILITY USING MECHANICAL SPECTROMETRY Ph.D. Thesis - Univ. Lyon 1, France [ETUDE PAR SPECTROMETRIE MECANIQUE DE LA MOBILITE MOLECULAIRE DANS DES ALLIAGES DE POLYMERES NON CRISTALLINS DE COMPATIBILITE DIFFERENTE]
Jean-Yves Cavaille 1987 176 p In FRENCH
(ISAL-87-0032; ETN-88-91632) Avail: NTIS HC A09/MF A01

The microstructure of amorphous polymers was studied. Models describing the glass transition of amorphous polymers and the theory of amorphous region deformation are discussed. Applications of mechanical spectrometry to the characterization of homogeneous or multiple phase polymer systems are examined. The structural evolution of homogeneous mixtures is studied. The results show that all systems studied present a secondary relaxation close to the alpha relaxation. The reason is found in the mobility of certain elements of the polymer main chain. ESA

N88-16884*# Boeing Aerospace Co., Seattle, Wash.
EVALUATION OF HIGH TEMPERATURE STRUCTURAL ADHESIVES FOR EXTENDED SERVICE, PHASE 5 Final Report
C. L. Hendricks, S. G. Hill, J. N. Hale, and W. G. Dumars Feb. 1987 68 p
(Contract NAS1-15605)
(NASA-CR-178176; NAS 1.26:178176) Avail: NTIS HC A04/MF A01 CSCL 11B

The evaluation of 3 experimental polymers from NASA-Langley and a commercially produced polymer from Mitsui Toatsu Chemicals as high temperature structural adhesives is presented. A polyphenylquinoxaline (PPQ), polyimide (STPI/LaRC-2), and a polyarylene ether (PAE-SO2) were evaluated as metal-to-metal adhesives. Lap shear, crack extension, and climbing drum peel specimens were fabricated from all three polymers and tested after thermal, combined thermal/humidity, and stressed hydraulic fluid (Skydrol) exposure. The fourth polymer, LARC-TPI was evaluated as an adhesive for titanium honeycomb sandwich structure. All three experimental polymers performed well as metal-to-metal adhesives from 219 K (-65 F) to 505 K (450 F), including humidity exposure. Structural adhesive strength was also maintained at 505 K for a minimum of 3000 hours. LaRC-TPI was evaluated as a high temperature (505 K) adhesive for titanium honeycomb sandwich structure. The LaRC-TPI bonding process development concentrated on improving the honeycomb core-to-skin bond. The most promising approach of those evaluated combined a LaRC-TPI polymer solution with a semi-crystalline LaRC-TPI powder for adhesive film fabrication and fillet formation. Author

N88-16885# Argonne National Lab., Ill.
IMAGE CORRELATION ON AN IBM-PC FOR CHARACTERIZATION OF ADVANCED CERAMICS
J. J. Vaitekunas, R. A. Roberts, and W. A. Ellingson Oct. 1987 24 p Presented at the Conference on Nondestructive Evaluation for Aerospace Requirements, Huntsville, Ala., 26 Aug. 1987
(Contract W-31-109-eng-38)
(DE88-002829; CONF-8708190-1) Avail: NTIS HC A03/MF A01

Digital images generated by data from ultrasonic scans, radiography, X- and gamma-ray CT (Computerized Tomography), and NMR (Nuclear Magnetic Resonance or MRI, Magnetic Resonance Imaging) often allow rapid visual interpretation of the data. Methods to compare the data generated and shown in the different images would be very useful. At Argonne an inexpensive, high resolution system was developed to provide a means of correlating information in the images generated by the different nondestructive evaluation (NDE) methods. This paper describes the imaging system developed at Argonne and some of the techniques used to aid in correlating features in the images generated by the NDE methods. DOE

N88-16886# Sandia National Labs., Albuquerque, N. Mex.
RESIDUAL STIFFNESS AND STRENGTH OF KEVLAR/EPOXY LAMINATED IMPULSIVELY LOADED TO 7.9 ktaps
T. R. Guess Nov. 1987 23 p
(Contract DE-AC04-76DP-00789)
(DE88-003724; SAND-87-1885) Avail: NTIS HC A03/MF A01

An experimental investigation of impulse-damaged composites is described. The purpose was to assess material property degradation in Kevlar/epoxy composites that had been subjected to impulse loads up to about 7.9 ktaps. These impulse loads produced intense short-duration compressive stress waves in flat composite panels. In most tests 25 to 45 percent of the initial composite thickness was delaminated (spalled) and removed from the back surface of the target. Optical inspection of residual target material did not reveal any matrix microcracking or delaminations away from the immediate vicinity of the spall surface of 0.125 and 0.25 inch thick targets; the 0.5 inch thick targets had some tensile stress induced delaminations. Specimens cut from residual targets and from as-fabricated materials were tested in tension, compression, four-point bend and three-point bend. There was basically no difference between the stress-strain responses of residual, impacted composite and as-fabricated composite samples. The load carrying capacity of the residual, impacted composites was reduced in proportion to the thickness of the material removed by spallation. Predictions of composite elastic properties were in good agreement with experimental values. Combined evidence of optical inspection and experimental results suggests that intense compression stresses did not significantly degrade the basic lamina properties of the Kevlar/epoxy composites investigated. DOE

N88-16887# Pacific Northwest Labs., Richland, Wash.
LFCM (LIQUID-FED CERAMIC MELTER) VITRIFICATION TECHNOLOGY Quarterly Progress Report, Oct. - Dec. 1986
R. A. Brouns, comp., C. R. Allen, comp., and J. A. Powell, comp. Sep. 1987 90 p
(Contract DE-AC06-76RL-01830)
(DE88-003441; PNL-6320-1) Avail: NTIS HC A05/MF A01

This report describes the progress in developing, testing, applying, and documenting liquid-fed ceramic melter (LFCM) vitrification technology. Progress in the following technical subject areas during the first quarter of FY87 is discussed. Topics include melting process chemistry and glass development, feed preparation and transfer systems, melter systems, off-gas systems, canister filling and handling systems, and process/product modeling. DOE

N88-16703*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SELF-LUBRICATING COATINGS FOR HIGH-TEMPERATURE APPLICATIONS
Harold E. Sliney *In its* Aeropropulsion '87. Session 1: Aeropropulsion Materials Research Nov. 1987 13 p (For primary document see N88-16697 09-07)
Avail: NTIS HC A06/MF A01 CSCL 11C

N88-16704*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
CERAMICS FOR ENGINES
James D. Kiser, Stanley R. Levine, and James A. DiCarlo *In its* Aeropropulsion '87. Session 1: Aeropropulsion Materials Research Nov. 1987 18 p (For primary document see N88-16697 09-07)
Avail: NTIS HC A06/MF A01 CSCL 11C

28 PROPELLANTS AND FUELS

Includes rocket propellants, igniters, and oxidizers; their storage and handling procedures; and aircraft fuels.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *44 Energy Production and Conversion.*

N88-16888# Ballistic Research Labs., Aberdeen Proving Ground, Md.

DSC (DIFFERENTIAL SCANNING CALORIMETER) STABILITY TEST FOR LIQUID PROPELLANTS: A PRELIMINARY REPORT Final Technical Report, Apr. - Dec. 1984

Robert A. Fifer and Pamela J. Duff Sep. 1987 30 p
(AD-A187115; BRL-TR-2837) Avail: NTIS HC A03/MF A01 CSCL 21I

The use of a Differential Scanning Calorimeter (DSC) for monitoring te stability of HAN based liquid propellants has been investigated. Preliminary experiments have been completed which establish criteria for obtaining reproducible initiation temperatures (T). Careful control of sample size (volume), inert sampling materials and operation at elevated pressure have yielded definitive T(in)S with the lowest standard deviation. Results for 1845 in aluminum pans at 6.9 MPa yielded an average T(in) of 120 C and standard deviation of 4 C, while an average T(in) of 124.8 and standard deviation of 2.4 was obtained for 13 M HAN in the presumably more inert tantalum pans at a somewhat lower pressure (5.2 MPa). Thus, it successfully used to monitor the relative stability of HAN-based propellants. The T(in) values obtained reflect initiation under the DSC conditions with small samples; no extrapolation o the ignition temperature of bulk HAN-based propellant under other conditions is attempted. GRA

N88-16889# Army Armament Research and Development Command, Dover, N. J. Armament Engineering Directorate.

ORGANIC COATINGS TO IMPROVE THE STORAGEABILITY AND SAFETY OF PYROTECHNIC COMPOSITIONS

Francis R. Taylor and Doris E. Jackson Nov. 1987 26 p
(AD-A187158; ARAED-TR-87022) Avail: NTIS HC A03/MF A01 CSCL 11C

A study was conducted to find organic coating which could be used to coat magnesium and aluminum powders used in pyrotechnic compositions. This coating material would greatly reduce, and possibly eliminate, the reaction of these finely divided and highly reactive metals with water vapor under storage conditions to produce hydrogen gas. Production of hydrogen gas in systems having minimal free volume can rupture cases and seals and also produce highly explosive atmospheres in storage magazines and warehouses. This reaction degrades the metal surfaces resulting in possible reduction in reactivity so essential in many flare applications. A second advantage of coating would be to reduce the sensitivities of the pyro compositions by introducing a somewhat unreactive medium (coating) between the metals and inorganic oxidants. GRA

N88-16890# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio.

MILITARY JET FUELS, 1944-1987 Summary Report, Oct. 1985 - Oct. 1987

Charles R. Martel Nov. 1987 67 p
(AD-A186752; AFWAL-TR-87-2062) Avail: NTIS HC A04/MF A01 CSCL 21D

This report consists of a brief history of US military fuels for aircraft turbine jet engines and ramjet engines. The report discusses the requirements of past and current US military jet fuel specifications, when and why the specification requirements originated, and the importance of these requirements today. The purpose and origin of the various specification test methods are presented, and an extensive discussion of jet fuel additives is provided. This report should be of value to anyone involved in research and development, logistics, and use of jet fuels. We hope that it will serve as a handy reference for the jet fuel specialist. GRA

N88-16891# Royal Aircraft Establishment, Farnborough (England).

FORMATION OF SEDIMENTS IN FUELS CONTAINING ADDED SULPHONIC ACIDS

R. W. Hiley Nov. 1986 20 p
(RAE-TM-NAV-ENG-1163; BR102337; ETN-88-91532) Copyright Avail: NTIS HC A03/MF A01

Catalytically cracked gas oil, normally unstable in storage, was extracted with 40 percent sodium hydroxide solution, yielding a very much more stable fuel. Portions of the extracted fuel were treated with sulfonic acids and stored at 43 C. Addition of the acids at levels as low as 10 ppm restores the instability of the extracted fuel and insoluble sediments are produced. The sediments were analyzed, using thin-layer chromatography, and infrared and mass spectroscopy, and compared with sediment generated by the raw untreated fuel with no additions. The sediments generated by the addition of sulfonic acids are similar to those produced by the untreated fuel. Minor differences are related to the two different sulfonic acids employed, providing evidence for incorporation of the sulfonic acids into the sediments. A fuel containing hydrotreated catalytically cracked gas oil, which did not produce sediment during 2 years of ambient storage, yields sediment very rapidly when treated with sulfonic acid. The sediment produced by this fuel is similar in nature to that produced by the raw catalytically cracked fuel. ESA

N88-16892# Aeronautical Research Labs., Melbourne (Australia).

MECHANISM OF AND PARTICLE SIZE EFFECTS ON SHOCK SENSITIVITY OF HETEROGENEOUS PRESSED EXPLOSIVES: PRELIMINARY ASSESSMENT OF BINDERLESS RDX IN FUZE TRAINS

Robert J. Spear and Victor Nanut Sep. 1987 32 p
(MRL-R-1077; AR-005-168) Avail: NTIS HC A03/MF A01

Shock initiation of pressed heterogeneous explosives is reviewed. The key processes of ignition and buildup and their relative importance under sustained and short duration shocks are described. Particle size effects on shock sensitivity are shown to depend on density and shock duration. M (sub 50 percent) values from gap tests often increase as particle size decreases. Below a critical particle size M (sub 50 percent) then decreases, as predicted from theoretical modeling. This trend was observed here for RDX. Assessment of fine RDX for fuse trains indicated its potential suitability. Author

29 MATERIALS PROCESSING

Includes space-based development of products and processes for commercial applications.

For biological materials see *55 Space Biology.*

N88-16783# European Space Agency, Paris (France). Microgravity Office.

MICROGRAVITY PAYLOADS AND MISSIONS FOR SPACE STATION: SOME ISSUES AFFECTING COMPATIBILITY WITH OTHER PAYLOADS

P. Clancy *In its* Proceedings of the ESA Workshop on Co-Orbiting Platform Elements (COPE) Sep. 1987 p 27-28 (For primary document see N88-16777 09-12)
Copyright Avail: NTIS HC A04/MF A01

N88-17435# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Cologne (West Germany). Inst. fuer Raumsimulation.

MICROGRAVITY EXPERIMENTS IN SPACE: COMPATIBILITY WITH DYNAMIC PERTURBING EFFECTS [MIKROGRAVITATIONS-EXPERIMENTE IM WELTRAUM - VERTRAEGLICHKEIT MIT DYNAMISCHEN STOEREINFLUESSEN]

Berndt Feuerbacher and Hans Hamacher *In its* Scientific Colloquium in Honor of Prof. Rer. Nat. Hermann L. Jordan Jun. 1987 p 57-71 In GERMAN (For primary document see

N88-17432 09-70)
Avail: NTIS HC A07/MF A01; DFVLR, Cologne, Fed. Republic of Germany DM 29

31 ENGINEERING (GENERAL)

Includes vacuum technology; control engineering; display engineering; cryogenics; and fire prevention.

N88-16893# Rolls-Royce Ltd., Derby (England). Precision Casting Facility.
DEVELOPMENT OF A SHELL SYSTEM FOR DS MOULDS AT RR PRECISION CASTING FACILITY
K. L. Harrison 24 Apr. 1987 8 p Submitted for publication
(PNR-90400; ETN-88-91529) Copyright Avail: NTIS HC A02/MF A01

Shells used in directional solidification casting of aircraft engine parts are described. Zircon flour slurry is used. Refractory stucco grains are still not ideal, and require two coats of shell to achieve the required thickness. Binder is hydrolyzed ethyl silicate, containing 24 percent silica. ESA

N88-16894# Institut National des Sciences Appliquees de Lyon, Villeurbanne (France). Lab. d'Informatique Appliquee.
CONTRIBUTION TO THE DESIGN OF FLEXIBLE MANUFACTURING SYSTEMS: MODELING, SIMULATION, AND EVALUATION OF PARAMETERS Ph.D. Thesis
Francoise Deloule 1987 233 p In FRENCH; ENGLISH summary
(ISAL-IDI1-87-04; ETN-88-91626) Avail: NTIS HC A11/MF A01

A machine shop design based on the Merise method is derived. The parameters of the physical system are identified and evaluated. Modeling and simulation are used as complementary methods to solve the problems created by the simultaneous variation of a large number of parameters. The specifications of machines and other elements implementing the flexible shop are obtained. A structured process to optimize the utilization of modeling and simulation is presented. It is shown that for given criteria the solution is close to the optimum. ESA

N88-16765# European Space Agency, Paris (France). Industrial Policy Dept.
EUROPEAN INDUSTRIAL CONSORTIA, FOR SPACE PROJECTS: THEIR ORIGINS, DEVELOPMENT AND POSSIBLE EVOLUTION
G. Dondi *In its* ESA Bulletin No. 24 Nov. 1980 p 72-78
(For primary document see N88-16755 09-12)
Copyright Avail: NTIS HC A05/MF A01

N88-17231*# TRW Defense Systems Group, Redondo Beach, Calif.
USER ENGINEERING: A NEW LOOK AT SYSTEM ENGINEERING
Larry L. McLaughlin *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 183-189
(For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 13B

32 COMMUNICATIONS AND RADAR

Includes radar; land and global communications; communications theory; and optical communications.

For related information see also *04 Aircraft Communications and Navigation* and *17 Space Communications, Spacecraft Communications, Command and Tracking.* For search and rescue see *03 Air Transportation and Safety,* and *16 Space Transportation.*

N88-16895# Clarkson Univ., Potsdam, N.Y. Div. of Research.
ADVANCED STUDIES OF INTEGRABLE SYSTEMS Final Report, 1 Jun. 1982 - 30 Sep. 1986
David J. Kaub 18 Dec. 1986 5 p
(Grant AF AFOSR-0154-82)
(AD-A186792; AFOSR-87-1412TR) Avail: NTIS HC A02/MF A01 CSCL 20C

Soliton Dynamics in the Presence of External Forces: a recent conjecture that solitons are not Newtonian particles is discussed. It is shown that whether or not Newtonian motion is observed will depend critically on the definition of the soliton's center. Nonlinear Scattering of Whistlers by Electrostatic Fluctuations: sharply localized; it is demonstrated that such distributions could possibly be explained by a modulational instability arising from interactions with ion-cyclotron waves. The Forced Toda Lattice: An example of an Almost Integrable System: forced integrable systems are discussed using the forced Toda lattice as an example. It is demonstrated how these systems are almost integrable. GRA

N88-16896# Naval Postgraduate School, Monterey, Calif.
EMISSION ANGLES FOR SOFT X-RAY COHERENT TRANSITION RADIATION M.S. Thesis
Robert M. Robinson Sep. 1987 46 p
(AD-A186851) Avail: NTIS HC A03/MF A01 CSCL 20H

Emission angles for both coherent and incoherent transition radiation in the soft X-ray region were measured. The results clearly show that coherent transition radiation produces larger emission angles at high beam energies than does incoherent radiation. These results allow the possibility of using coherent transition to measure higher electron beam energies than are possible using incoherent radiation approximations. The measured emission angle magnitudes are compared to theoretical values obtained using computer simulation. Differences are noted and possible sources of error are cited. GRA

N88-16897# Massachusetts Inst. of Tech., Cambridge. Lab. for Computer Science.
REPLICATION AND RECONFIGURATION IN A DISTRIBUTED MAIL REPOSITORY
Mark S. Day Apr. 1987 116 p
(Contract N00014-83-K-0125)
(AD-A186967; MIT/LCS/TR-376) Avail: NTIS HC A06/MF A01 CSCL 17B

Conventional approaches to programming produce centralized programs that run on a single computer. However, an unconventional approach can take advantage of low-cost communication and small, inexpensive computers. A distributed program provides service through programs executing at several nodes of a distributed system. Distributed programs can offer two important advantages over centralized programs: high availability and scalability. In a highly-available system, it is very likely that a randomly-chosen transaction will complete successfully. A scalable system's capacity can be increased or decreased to match changes in the demands placed on the system. When a node is unavailable because of maintenance or a crash, transactions may fail unless copies of the node's information are stored at other nodes. Thus, high availability requires replication of data. This thesis considers the problem of building scalable and highly-available distributed programs without using special processors with redundant hardware and software. It describes a design and implementation of an example distributed program, an electronic mail repository. The thesis focuses on how to design and implement replication and reconfiguration for the distributed mail repository. GRA

N88-16898# Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio.
TEAM PROBLEM SOLVING: EFFECTS OF COMMUNICATION AND FUNCTION OVERLAP Final Report, 15 Jun. 1985 - 15 Jun. 1986
Erhard O. Eimer Mar. 1987 49 p
(AD-A187010; AAMRL-TR-87-037) Avail: NTIS HC A03/MF A01 CSCL 05E

A theoretical framework is developed to assess factors that affect crew productivity in problem solving tasks. A taxonomic analysis is expanded to consider interrelations between categories of factors, namely characteristics of resources, of the task, and of the group. Experimental results are presented to examine the effect of degree of communication and of function overlap on problem solving by two-person crews. The data suggest that communication facilitates problem solving when there is no function overlap; when communication is restricted, problem solving is impeded when there is partial overlap of function. The findings are discussed with a focus on the concept that crew behavior is not a simple aggregation of the contributions made by individual crew members. GRA

N88-16899# Massachusetts Inst. of Tech., Cambridge. Lab. for Computer Science.
APPROXIMATING THE SIZE OF A DYNAMICALLY GROWING ASYNCHRONOUS DISTRIBUTED NETWORK
Baruch Awerbuch and Serge A. Plotkin Apr. 1987 20 p
(Contract N00014-80-C-0622)
(AD-A187011; MIT/LCS/TM-328) Avail: NTIS HC A03/MF A01 CSCL 17B

We show how to approximate up to a constant factor the size of a dynamically growing asynchronous distributed network. The technique presented in this paper has an amortized message complexity of O(log 2 V) per node, where V is the final size of the network. This technique appears to be useful in constructing distributed algorithms. In this paper we show how to apply this technique to construct an efficient distributed algorithm for leader election in a faulty network. The algorithm has a message complexity O(E + V log 2 V), which is in an improvement of O(log 2 V) over the previously known algorithms. GRA

N88-16900# University of Southern California, Los Angeles. Dept. of Electrical Engineering.
ADAPTIVE SPREAD SPECTRUM NETWORKS Final Report, 1 Jul. 1984 - 30 Jun. 1987
J. A. Silvester and A. Polydoros Sep. 1987 33 p
(Contract DAAG29-84-K-0084)
(AD-A187154; ARO-21665.22-EL) Avail: NTIS HC A03/MF A01 CSCL 17B

This report contains abstracts of all papers published during the course of the research. GRA

N88-16901# Naval Postgraduate School, Monterey, Calif.
OPTIMIZING HF ANTENNA SYSTEMS ON THE DOLPHIN AND SEA HAWK HELICOPTERS M.S. Thesis
James B. Crawford Sep. 1987 394 p
(AD-A186552) Avail: NTIS HC A17/MF A01 CSCL 01C

Making an aircraft available and modifying it to test various antenna systems and configurations is extremely costly. The computer model is an excellent alternative means of analyzing antenna systems for optimum communication system performance. In this study electromagnetic wire grid computer models of two helicopters and eight HF antenna configurations are developed using Interactive Graphics Utility for Automated NEC Analysis (IGUANA). Numerical Electromagnetics Code (NEC) is used to obtain radiation patterns, and the Advanced Prophet program is used to develop the criteria for judging system effectiveness. These computer results compare favorably with test range data, showing great savings of cost. They provide the additional advantage of showing radiation patterns at an elevated angle for sky wave propagation analysis (patterns which cannot be obtained on an antenna test range). GRA

N88-16902# Naval Environmental Prediction Research Facility, Monterey, Calif.
METEOROLOGICAL RADAR AND ITS USAGE IN THE NAVY Final Report, Jan. 1986 - Mar. 1987
Louis A. Hembree, Jr Jul. 1987 67 p
(AD-A186650; TR-87-01) Avail: NTIS HC A04/MF A01 CSCL 20N

The basic principles of radar meteorology are presented along with the current capabilities of meteorological radars. Factors that need to be examined when evaluating a radar for meteorological applications are also discussed. The current use of radars for meteorological measurements within the Navy is presented along with possible future applications. It is concluded that Doppler meteorological radar data could have significant impact on Naval operations. It is recommended that the replacement for the FPS-106 have Doppler capability with at least intensity and velocity displays. It is further recommended that the radar have the capacity to apply various application algorithms to the data. The ability to process weather information should be added to suitable afloat tactical radars. GRA

N88-16903# Iowa State Univ. of Science and Technology, Ames.
TRANSIENT ELECTROMAGNETIC SCATTERING FROM HETEROGENEOUS LOSSY SPHERES Final Report, 1 Jul. - 30 Sep. 1986
Jim Corones 15 Jan. 1987 2 p
(Grant AF-AFOSR-0259-86)
(AD-A186669; AFOSR-87-1406TR) Avail: NTIS HC A02/MF A01 CSCL 20N

Eleven papers were published documentary work performed under this grant, and 14 lectures were presented. Several mathematical results were obtained concerning the performance of protocols for pocket switching, local area networks, and satellite communications. In particular, results concerning the stability of the exponential backoff protocol were obtained. GRA

N88-16904# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany). Abteilung Hochfrequenzphysik.
ANALYSIS OF ELECTROMAGNETIC WAVE PROPAGATION IN SLIGHTLY INHOMOGENEOUS HOLLOW WAVEGUIDES Ph.D. Thesis - Technische Hochschule, Darmstadt, Federal Republic of Germany
Klaus Werner Kark Jun. 1987 288 p In GERMAN; ENGLISH summary
(DFVLR-FB-87-23; ISSN-0171-1342; ETN-88-91010) Avail: NTIS HC A13/MF A01; DFVLR, Cologne, Federal Republic of Germany DM 85

The electromagnetic boundary value problem was treated for lossless hollow waveguides with circular cross section. Starting from the canonical problem of the homogeneous circular cylinder, the influence of small changes of the cross-sectional radius and of a slightly bent longitudinal axis on the stationary field problem was determined. Because the shape of the hollow waveguide changes only slowly, approximate analytical solutions of the field equations can be found using an improved adiabatic mode theory and a perturbational approach following Rayleigh and Schroedinger. ESA

N88-16905# TICRA A/s, Copenhagen (Denmark).
STUDY OF DUAL BEAM ANTENNA SYSTEMS FOR THE DATA RELAY SATELLITE, VOLUME 1 Final Report
Peter Balling Paris, France ESA Feb. 1986 125 p
(Contract ESTEC-6317/85-NL-DG)
(S-272-02-Vol-1; ESA-CR(P)-2495-Vol-1; ETN-88-91428) Avail: NTIS HC A06/MF A01

Dual beam antenna configurations for the Data Relaying Satellite were identified. They are: (1) offset spherical reflector with beam waveguide requiring az/el movements only; (2) single center-fed reflector with beam waveguide in which the distance between the mirrors is varied; (3) single reflector with large movable, shaped subreflector; (4) side-fed offset Cassegrain or front-fed offset

Cassegrain with movable BWG Ka-band feed and S-band feed array; (5) fixed Ka- and S-band feeds with two independent rotatable reflectors; (6) fixed Ka- and S-band feeds and fixed reflector with two independently rotatable large plates; and (7) near-field Gregorian and Cassegrain systems with rotatable Ka-band feed plate. Configuration (3) was discarded, (1) and (2) are shown to be feasible; and (4) to (7) were only evaluated subjectively. Stringent electrical performance requirements and the preference for a fixed feed and a fixed reflector can be met but at the cost of significant mechanical complexity. ESA

N88-16906# TICRA A/s, Copenhagen (Denmark).
STUDY OF DUAL BEAM ANTENNA SYSTEMS FOR THE DATA RELAY SATELLITE. VOLUME 2: EXECUTIVE SUMMARY
Peter Balling Paris, France ESA Feb. 1986 39 p
(Contract ESTEC-6317/85-NL-DG)
(S-272-03-Vol-2; ESA-CR(P)-2495-Vol-2; ETN-88-91429) Avail: NTIS HC A03/MF A01

Dual beam antenna configurations for the Data Relaying Satellite were identified. They are: (1) offset spherical reflector with beam waveguide requiring az/el movements only; (2) single center-fed reflector with beam waveguide in which the distance between the mirrors is varied; (3) single reflector with large movable, shape subreflector; (4) side-fed offset Cassegrain or front-fed offset Cassegrain with movable BWG Ka-band feed and S-band feed array; (5) fixed Ka- and S-band feeds with two independent rotatable reflectors; (6) fixed Ka- and S-band feeds and fixed reflector with two independently rotatable large plates; and (7) near-field Gregorian and Cassegrain systems with rotatable Ka-band feed plate. Configuration (3) was discarded, (1) and (2) are shown to be feasible; and (4) to (7) were only evaluated subjectively. Stringent electrical performance requirements and the preference for a fixed feed and a fixed reflector can be met but at the cost of significant mechanical complexity. ESA

N88-16907# Helsinki Univ. of Technology, Espoo (Finland). Electromagnetics Lab.
EXACT IMAGE PRINCIPLE IN ELECTROMAGNETIC FIELD COMPUTATION Ph.D. Thesis
Esko Alanen 1987 36 p Sponsored by the Academy of Finland
(EI-57; ISBN-951-666-242-0; ISSN-0001-6845; ETN-88-91658)
Avail: NTIS HC A03/MF A01

The basic idea and mathematical formulation of the exact image principle for electromagnetic field calculation is presented. The principle can be applied in problems with planar interfaces, such as antennas near the ground surface, microstrip structures, field radiation through the interface, or radiation in biological media. It is assumed that media are isotropic and the fields are time-harmonic. The exact field solutions are presented using continuous image current distributions situated partly in complex space. The principle is compared with Sommerfeld integration. Applications of the method: the effect of the ground on the input impedance of short vertical dipoles; power line field calculation; radiation of a horn antenna in contact with the human skin; and microstrip field calculation are shown. ESA

N88-16908# TICRA A/s, Copenhagen (Denmark).
STUDY ON A DOUBLE REFLECTOR COMPACT RANGE Final Report
Frank Jensen Paris, France ESA Dec. 1985 186 p
(Contract ESA-5635/83-NL-GM)
(S-201-05; ESA-CR(P)-2514; ETN-88-91708) Avail: NTIS HC A09/MF A01

Mechanical tolerances and design of a compact far field antenna test range (CAR) were analyzed. A software package for determining the field in the test zone (aperture) of the CAR and the coupling to a given test antenna was developed. The study demonstrates drawbacks of the CAR due to the design based on cylindrical reflectors. Since it is not planned to use this reflector shape in the manufacturing, an alternative design based on doubly curved reflectors is presented. With this design the inherent cross polarization is cancelled and the scan properties of the CAR are considerably improved. ESA

N88-16909# Institut fuer Rundfunktechnik, Munich (West Germany).
CONSIDERATIONS CONCERNING THE BASIC BANDWIDTH REDUCTION OF HIGH DEFINITION TELEVISION SYSTEMS (HDTV) COMPONENT SIGNALS, BASED ON PSYCHOPHYSIOLOGICAL PROPERTIES OF THE EYE [BETRACHTUNGEN ZUR EINSCHRAENKUNG DER BASISBANDBREITE VON HDTV-KOMPONENTENSIGNALEN, BASIEREND AUF PSYCHO-PHYSIOLOGISCHEN EIGENSCHAFTEN DES AUGES]
G. Holoch Bonn, West Germany Bundesministerium fuer Forschung und Technologie 6 Mar. 1987 31 p In GERMAN
(Contract BMFT-01-YH-85-01-3)
(IRT-B-83/87; ETN-88-91069) Avail: NTIS HC A03/MF A01

Psychophysiological properties of human vision are described, with a view to a reduction of irrelevant signal components in the transmission of TV component signals. The space-time frequency response of human vision, and the sensitivity of the eye to diagonal structures, peripheral vision, and luminosity graduation are discussed. Based on these characteristics, scanning and filtering methods are proposed. It is shown that a compression of the bandwidth to 4.6 MHz is possible provided a spatial resolution of 14 periods/deg for the brilliance signal (18 MHz) is realized using diagonal filtering, offset scanning, and vertical subscanning. ESA

N88-16910# Royal Aircraft Establishment, Farnborough (England).
THE RATIO DETECTOR: A METHOD OF AMPLITUDE INSENSITIVE FREQUENCY DEMODULATION
J. L. Johnston Feb. 1987 53 p
(RAE-TR-87008; RAE-RAD-NAV-150; BR102983; ETN-88-91533)
Copyright Avail: NTIS HC A04/MF A01

Design procedures for the construction of ratio detectors constrained to have a low center frequency but wide bandwidth for a frequency hopping system sending voice and 16 k band data are presented. Two methods of constructing the transformer are given and results compared. One detector is further analyzed, but it is concluded that both methods are suitable for low frequency ratio detector construction. ESA

N88-16911# Royal Signals and Radar Establishment, Malvern (England).
AN INTRODUCTION TO MILITARY SATELLITE COMMUNICATIONS
T. C. Tozer Apr. 1987 39 p
(RSRE-MEMO-3976; BR103611; ETN-88-91536; AD-A187005)
Copyright Avail: NTIS HC A03/MF A01

Military satellite communication system design, and the state of the art in space and ground segments are introduced. Differences with civilian systems are shown. ESA

N88-16912# Royal Signals and Radar Establishment, Malvern (England).
PLANE WAVE DIFFRACTION BY A THIN DIELECTRIC WEDGE
I. D. King May 1987 28 p
(RSRE-MEMO-4045; BR103079; ETN-88-91539) Copyright
Avail: NTIS HC A03/MF A01

The diffraction of a plane electromagnetic wave by a thin dielectric wedge is studied using a set of approximate boundary conditions together with the Wiener-Hopf technique. An integral expression for the scattered field is derived and the diffracted far field obtained by application of the method of steepest descents. The associated geometrical theory of diffraction coefficients are exact to order 0(A sq) where 2A is the (small) wedge angle. The results are useful for wedges for which /nsq-1/A much less than 1, where n is the refractive index of the dielectric relative to that of the surrounding medium. ESA

N88-16913# Institut Franco-Allemand de Recherches, St. Louis (France).
DIELECTRIC BEHAVIOR OF ELECTROMAGNETIC (EM) WINDOWS MATERIALS IRRADIATED BY A CW CO2 HIGH-POWER LASER
J. Pierson 21 Oct. 1986 10 p Presented at the Eighteenth Symposium on Electromagnetic Windows, Atlanta, Ga., 17-19 Sep. 1986
(ISL-CO-239/86; ETN-88-91634) Avail: NTIS HC A02/MF A01

Infrared laser interaction with radome materials was studied. Dielectric properties of plastic radome materials are deeply damaged by a laser interaction. Damage occurs for a few hundred W/sqcm laser density and a few seconds irradiation time. Among the ceramic and glassy materials, fused and slip-cast silica endure laser irradiation very well. They withstand the strong thermal shock; their permittivity does not change much. Their destruction occurs by surface vaporization at a temperature greater than 300 K. ESA

N88-16914# Research Inst. of National Defence, Linkoeping (Sweden).
MOVING TARGET INDICATOR (MTI) INTERFACE FOR SIMPLE RADAR
Erik Arvidsson Sep. 1987 28 p In SWEDISH; ENGLISH summary
(FOA-C-30463-3.2; ISSN-0347-3708; ETN-88-91673) Avail: NTIS HC A03/MF A01; Research Institute of National Defence, Stockholm, Sweden KR 50

A digital moving target indicator (MTI) interface was designed for simple and cheap marine radar. The MTI interface circuit uses digital Doppler filters and fast digital components. The results show that it is possible for land based radar to separate moving target echoes from ground echoes sufficiently, for several applications. Using a switch, one may choose between an MTI video or a normal video. The MTI equipment is good for a distance up to 9600 m, and the normal one for longer distances. The MTI interface allows a ground echo reduction of 40 to 30 dB. Examples of images of aircraft, helicopters, and moving cars are presented. ESA

N88-16915# European Space Agency, Paris (France).
BACKSCATTERING SIGNAL ANALYSIS CONCERNING A THREE-DIMENSIONAL OBJECT CONFIGURATION ON THE BASIS OF OBJECT MOTION
Franz Heel Sep. 1987 139 p Transl. into ENGLISH of Analyse des Rueckstreusignals einer Dreidimensionalen Streuzentrenanordnung auf der Grundlage der Objektbewegung (DFVLR, Oberpfaffenhofen, Fed. Republic of Germany), 1986 Original language document was announced as N87-17988
(ESA-TT-1044; DFVLR-FB-86-36; ETN-88-91711) Avail: NTIS HC A07/MF A01; original German version available from DFVLR, Cologne, Fed. Republic of Germany DM 39.50

A radar signal procedure to realize a three-dimensional object image dependent on the object motion is described. Concerning the scattering centers, the instantaneous Doppler frequency characteristics caused by simultaneous linear and rotating object motion are derived from the backscattered signal. By simulating the time sequence of the instantaneous Doppler frequency spectra, the Doppler frequency characteristics, including the flight path and object parameters, can be approximated. A gradually working image formation procedure is developed, which results in a three-dimensional object image represented in front and side-view. ESA

N88-16916# Helsinki Univ. of Technology, Espoo (Finland). Radio Lab.
CONSTRUCTION OF AIRBORNE RADARS FOR REMOTE SENSING Progress Report, 1 Jul. 1986 - 30 Jun. 1987
M. Hallikainen, J. Hyyppae, M. Toikka, T. Forsell, and J. Haapanen 1987 24 p
(PB88-113063; S-171; ISBN-951-754-210-0) Avail: NTIS HC A03/MF A01 CSCL 20N

The progress made in the radar construction project from 1 July 1986 through 30 June 1987 is described. The project includes the design and construction of two airborne systems for microwave remote sensing. The dual-frequency scatterometer system will operate at 5 and 10 GHz and it will be used both for extensive data collection campaigns and for detailed investigations of the scattering properties of various targets. The primary uses of the 10 GHz side-looking airborne radar (SLAR) will be detection of oil slicks and mapping of sea ice. GRA

N88-16917# Technische Hogeschool, Delft (Netherlands). Afdeling der Elektrotechniek.
COMPUTATIONAL ANALYSIS OF PROPAGATION PROPERTIES OF INTEGRATED-OPTICAL WAVEGUIDES USING A DOMAIN INTEGRAL EQUATION
J. M. vanSplunter, H. Blok, N. H. G. Baken, and M. F. Dane Aug. 1986 7 p
(PB87-163358; Rept-1986-22) Avail: NTIS HC E03/MF E01 CSCL 20N

A domain-integral-equation approach is developed to compute the propagation properties and field distributions of surface-wave modes in diffused channel waveguides in or on a substrate. In this approach the waveguide channel is taken as a local perturbation of a configuration consisting of a semi-infinite substrate and a semi-infinite superstrate. The perturbation is considered as an equivalent contrast source. Using the electric Green's function of the two-media configuration, the problem is transformed into a homogeneous system of domain integral equations. This system is solved numerically by using the method of moments combined with a point-matching technique. Numerical results are given for various diffused channel waveguides. GRA

N88-16918*# Johns Hopkins Univ., Baltimore, Md. Dept. of Electrical and Computer Engineering.
OPTICAL COMMUNICATION WITH SEMICONDUCTOR LASER DIODES Interim Progress Report, 1 Jul. - 31 Dec. 1987
F. Davidson 7 Mar. 1988 35 p
(Grant NAG-356)
(NASA-CR-182464; NAS 1.26:182464) Avail: NTIS HC A03/MF A01 CSCL 17B

Slot timing recovery in a direct detection optical PPM communication system can be achieved by processing the photodetector waveform with a nonlinear device whose output forms the input to a phase lock group. The choice of a simple transition detector as the nonlinearity is shown to give satisfactory synchronization performance. The rms phase error of the recovered slot clock and the effect of slot timing jitter on the bit error probability were directly measured. The experimental system consisted of an AlGaAs laser diode (lambda = 834 nm) and a silicon avalanche photodiode (APD) photodetector and used Q=4 PPM signaling operated at a source data rate of 25 megabits/second. The mathematical model developed to characterize system performance is shown to be in good agreement with actual performance measurements. The use of the recovered slot clock in the receiver resulted in no degradation in receiver sensitivity compared to a system with perfect slot timing. The system achieved a bit error probability of 10 to the minus 6 power at received signal energies corresponding to an average of less than 60 detected photons per information bit. Author

N88-16919# Sandia National Labs., Albuquerque, N. Mex.
A HYBRID TRANSFORM/DPCM ENCODER FOR DATA COMPRESSION
S. D. Gray Oct. 1987 35 p
(Contract DE-AC04-76DP-00789)
(DE88-003725; SAND-87-2215) Avail: NTIS HC A03/MF A01

A new technique for the transmission of video is presented in this paper. It incorporates several ideas that enable a significant reduction in the data rate over a straightforward pulse code modulation (PCM) system. Theoretical expressions are presented to give a firm background in how the procedure works and what are its limitations. Although the proposed system contains a considerable amount of computational sophistication, an emphasis

has been placed on portable applications. To back up these ideas and allow the reader to judge the effectiveness of this procedure, several photographs are included. DOE

N88-16920# Lawrence Livermore National Lab., Calif.
EVALUATION OF CWMS (CONTINUOUS-WAVE MEASUREMENT SYSTEM) SINGLE-WIRE DIPOLE ANTENNA
J. K. Breakall and A. M. Christman 30 Nov. 1987 100 p
(Contract W-7405-eng-48)
(DE88-003979; UCID-21247) Avail: NTIS HC A05/MF A01

The Numerical Electromagnetics Code (NEC) was used to model a single-wire horizontal dipole antenna used with the FCDNA Continuous-Wave Measurement System (CWMS). Line drawings and construction information were supplied to LLNL staff by FCDNA and EGG personnel, and NEC models were developed accordingly. Data were obtained from NEC describing all components of the electric and magnetic fields at nine different field-strength measurement points, as well as the input impedance at the antenna feed-point. Thirteen frequencies were used in the model, ranging all the way from 10 kHz to 100 MHz. In addition, the antenna was examined in two configurations, with and without a coaxial transmission line which extended from the feed-point balun to ground level. DOE

N88-16921 British Broadcasting Corp., Kingswood (England). Engineering Div.
THE ASSESSMENT OF THE SOUND INSULATION REQUIREMENTS FOR A LARGE BROADCASTING STUDIO, USING A SCALE MODEL: THEORETICAL CONSIDERATIONS
E. W. Taylor Dec. 1987 17 p
(BBC-RD-1987/20; PH-286) Avail: Issuing Activity

The theory of sound transmission into a reverberant enclosure is discussed, particularly for the cases where more than one transmitting panel is involved, and where the source sound field may be either reverberant or direct. The coherence properties of road traffic noise and filtered white noise are also examined, and the implications of the presence of coherent or partially coherent noise are considered, particularly in relation to the field measurement of road traffic noise near sound reflecting surfaces. Author

N88-16922 British Broadcasting Corp., Kingswood (England). Engineering Div.
EXPERIMENTAL RADIO DATA SYSTEM (RDS): A SURVEY OF RECEPTION RELIABILITY IN THE UK
A. G. Lyner Nov. 1987 27 p
(BBC-RD-1987/17) Avail: Issuing Activity

The Report describes a field survey which was made to investigate the reliability of reception of the Radio Data System (RDS). Trade-test transmissions of RDS were introduced on all BBC Band II VHF/FM radio signals broadcast in England in August 1987. A full public service of RDS is expected to commence in England in mid-1988. The survey covered both mobile (car) and static (domestic) reception under various conditions. During the survey a microcomputer was used in the survey vehicle to analyze and log the data gathered about reception of the RDS data. Particular attention was given to investigating the reliability of reception of RDS under poor receiving conditions sometimes experienced in moving vehicles. The survey related reliability of RDS reception to quality of received sound program. The RDS reception analysis is given in terms of waiting-time for correct codes (noise performance in terms of bit-error-ratio statistics are not dealt with, having been studied elsewhere). Author

N88-16923 British Broadcasting Corp., Kingswood (England). Engineering Div.
FUTURE TELEVISION SYSTEMS: COMPARISON OF SEQUENTIAL AND INTERLACED SCANNING
C. K. P. Clarke Nov. 1987 13 p
(BBC-RD-1987/18) Avail: Issuing Activity

In the broadcast television environment, interlaced scanning is universal, although the advantage it has over the inherently simpler sequential scan is not obvious. By examining the fundamentals of television scanning in frequency-domain terms, it is concluded that the main benefit of interlaced scanning is that it is better matched to the slow roll-off vertical frequency characteristic of the cathode-ray tube with the result that the line structure is less noticeable. With advances in technology, other methods of improving the displayed picture quality can be considered, such as up-conversion in the display to higher line and field rates. However, this conversion process would be considerably simpler with a sequential input to the display unit and might more successfully overcome the movement problems of interlaced scanning in which vertical and temporal frequencies are difficult to distinguish. This preference for a sequential input to the display unit brings with it a desirability to broadcast and possibly also to originate the television signals in sequential form. Moreover, in this context, it is considered that sequential scanning may have further advantages, both simplifying down-conversion from higher scanning rate used in the camera and making low field-rate, movement compensated bandwidth compression techniques more effective. It is concluded, therefore, that sequential scanning may have an important part to play in the development of future television systems. Author

N88-16924 British Broadcasting Corp., Kingswood (England). Engineering Div.
LIMITING OF YUV DIGITAL VIDEO SIGNALS
V. G. Devereux Dec. 1987 20 p
(BBC-RD-1987/22; PH-285) Avail: Issuing Activity

Methods of limiting excessive YUV component video signals so that the corresponding RGB components lie within specified limits are discussed. In the proposed methods, YUV limits derived from the RGB limits are applied directly to YUV component signals without any intermediate conversion of signals into RGB form. Tests have shown that a very satisfactory basis for YUV limitation is to arrange that both hue and luminance remain unaltered by the process. Software techniques for processing stored video data and hardware techniques for processing real-time video signals are both described. Author

N88-16925 Illinois Univ., Urbana-Champaign.
INVESTIGATION OF ITERATIVE AND SPECTRAL GALERKIN TECHNIQUES FOR SOLVING ELECTROMAGNETIC BOUNDARY VALUE PROBLEMS Ph.D. Thesis
Chi Hou Chan [1987] 235 p
Avail: Univ. Microfilms Order No. DA8721601

Iterative approaches to solving electromagnetic boundary value problems have the advantage that they enable the investigation of problems that require dealing with a large number of unkowns, and are consequently intractable using conventional matrix methods. Iterative schemes are developed by viewing the iterative problem as that of reducing the norm of the error in the satisfaction of the boundary condition. Different iterative schemes are devised by choosing different direction vectors to represent the unknowns. These iterative algorithms are applied to solve a wide variety of electromagnetic boundary value problems. It was found that the basis and testing functions employed to discretize the continuous operator plays an important role in the rate of convergence of the iterative solution. There is another type of boundary value problem that requires the solution of an eigenvalue equations, and is not amenable to solution using itertive approaches. An alternative approach, called the spectral Galerkin technique, can be used to solve this type of problem. The spectral Galerkin technique is applied to calculate the radar cross-section (RCS) of a large scatterer for a wide range of aspect angles. Most of the calculations were performed using the Cray X-MP supercomputer. It is demonstrated that numerically rigorous, and yet efficient, solutions to the electromagnetic boundary value problems requiring a large number of unknowns are feasible using the technique described. Dissert. Abstr.

N88-16926 Cornell Univ., Ithaca, N.Y.
HIGH PERFORMANCE VLSI ALGORITHMS AND ARCHITECTURES FOR DIGITAL SIGNAL PROCESSING Ph.D. Thesis

Paul Ming Yu Chau [1987] 467 p
Avail: Univ. Microfilms Order No. DA8724120

The results of a study of the algorithms, architecture, IC chips design considerations, and figure of merit evaluation for the application of Very Large Scale Integration (VLSI) technology to high performance Digital Signal Processing (DSP) are presented. A modified version of the Cooley-Tukey Fast Fourier Transformation (FFT) algorithm was formalized to enhance its adaptability to VLSI implementation. Practical research work is described for the architecture, design, and building of VLSI DSP chips based upon the FFT formulation. The architectures for next generation signal processors are examined. The results of a tradeoff study of the increased numerical performance and dynamic range offered by a floating-point VLSI DSP processor over its fixed and block floating-point counterparts are produced. Dissert. Abstr.

N88-16927# Oak Ridge National Lab., Tenn.
CROSSTALK ANALYSIS OF A BROADBAND DATA COMMUNICATIONS SYSTEM
R. I. Crutcher, P. D. Ewing, and T. W. Hayes Nov. 1987 42 p
(Contract DE-AC05-84OR-21400)
(DE88-003652; ORNL-6431) Avail: NTIS HC A03/MF A01

A broadband cable system represents a significant resource for data transmission within a facility. Duplication of a broadband network to provide services of varying sensitivity levels within the same area is wasteful of capital resources. The sharing of a network by different data services is financially attractive providing that sensitive data are inaccessible from nonsensitive ports. The use of equipment from two manufacturers introduces a deliberate incompatibility for the purpose of data isolation. This report presents test results obtained by this technique. DOE

N88-16928*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
NUMERICAL ARC SEGMENTATION ALGORITHM FOR A RADIO CONFERENCE-NASARC, VERSION 2.0: USER'S MANUAL
Wayne A. Whyte, Jr., Ann O. Heyward, Denise S. Ponchak, Rodney L. Spence, and John E. Zuzek 16 Oct. 1987 93 p
(NASA-TM-100161; E-3723; NAS 1.15:100161) Avail: NTIS HC A05/MF A01 CSCL 17B

The information contained in the NASARC (Version 2.0) Technical Manual (NASA TM-100160) and the NASARC (Version 2.0) User's Manual (NASA TM-100161) relates to the state of the Numerical Arc Segmentation Algorithm for a Radio Conference (NASARC) software development through October 16, 1987. The technical manual describes the NASARC concept and the algorithms which are used to implement it. The User's Manual provides information on computer system considerations, installation instructions, description of input files, and program operation instructions. Significant revisions have been incorporated in the Version 2.0 software over prior versions. These revisions have enhanced the modeling capabilities of the NASARC procedure while greatly reducing the computer run time and memory requirements. Array dimensions within the software have been structured to fit into the currently available 6-megabyte memory capacity of the International Frequency Registration Board (IFRB) computer facility. A piecewise approach to predetermined arc generation in NASARC (Version 2.0) allows worldwide scenarios to be accommodated within these memory constraints while at the same time reducing computer run time. Author

N88-16725# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Space Communications Div.
EUROPEAN DEVELOPMENTS IN ANTENNA TECHNOLOGY
J. Aasted *In its* ESA Bulletin No. 8 Feb. 1977 p 48-53
(For primary document see N88-16718 09-12)
Avail: NTIS HC A05/MF A01

N88-16760# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Data Handling Div.
EARTHNET'S EXPERIENCE WITH SEASAT SAR IMAGE PROCESSING
J. P. Guignard *In its* ESA Bulletin No. 24 Nov. 1980 p 40-45 (For primary document see N88-16755 09-12)
Copyright Avail: NTIS HC A05/MF A01

33 ELECTRONICS AND ELECTRICAL ENGINEERING

Includes test equipment and maintainability; components, e.g., tunnel diodes and transistors; microminiaturization; and integrated circuitry.

For related information see also *60 Computer Operations and Hardware* and *76 Solid-State Physics.*

N88-16929# University of Southern California, Los Angeles. Center for Laser Studies.
STUDIES ON NONLINEAR MECHANISMS OF EXCIMER LASER PROPAGATION IN FUSED SILICA FIBERS Final Report, 1 May 1985 - 30 Apr. 1987
Elsa Garmire 31 Jul. 1987 40 p
(Grant AF AFOSR-0197-85)
(AD-A186822; CLS-87-15; AFOSR-87-1372TR) Avail: NTIS HC A03/MF A01 CSCL 09C

This study was to investigate the potential for short wavelength generation through Raman up conversion in ultraviolet transmitting fibers. The study resulted in three key achievements: (1) Identification of induced absorption in fused silica UV fibers due to color center formation with the excimer laser at 193 nm. Optical bleaching to reverse the induced absorption was observed by using a longer wavelength of the excimer laser (XeF at 351 nm). A maximum recovery of 70 percent of initial transmission was obtained. This is the first time that color center formation and subsequent bleaching has been reported in UV transmitting fibers. (2) Development of new means to image single pulses from the excimer laser, utilizing a phosphor to down convert the image to videorecorder. (3) Study of Raman up conversions using excimer lasers. Comparison was made of fibers vs. Raman resonators. Limited coherence length because of the bandwidth spread of excimer lasers and unavailability of low-mode-number UV fibers are reasons why the Raman resonator appears to be a reasonable approach. GRA

N88-16930# Texas Instruments, Inc., Dallas.
NANOELECTRONICS Final Technical Report, 15 Jun. 1984 - 14 Jun. 1987
R. T. Bate, M. A. Reed, and W. R. Frensley 14 Aug. 1987 231 p
(Contract DAAG29-84-C-0009)
(AD-A186969; TI-08-87-50; ARO-21243.11-EL) Avail: NTIS HC A11/MF A01 CSCL 20J

Results of theoretical and experimental research on resonant tunneling diodes are reported. Of particular interest were the effects of restriction of the lateral dimensions of the device to achieve quantum confinement of electrons in all three dimensions. The theoretical efforts within this program were devoted to applying a quantum-transport approach to understanding the behavior of the resonant-tunneling diode. When this program began, there had been no demonstration of total spatial quantization in a fabricated semiconductor system. We pioneered work in this field by investigating the photoluminescence of laterally confined multiple quantum wells, known as quantum dots. The results gave the first evidence for spatial quantization in a fabricated system and have stimulated considerable activity in the creation of microfabricated quantum structures. We undertook an extensive study of resonant tunneling in GaAs structures as a baseline approach. We investigated excited state resonant tunneling and were the first to show clear negative differential resistance because of resonant tunneling through excited states. We fabricated and electrically

characterized quantum dot resonant tunneling structures. Effort was also expended on fabrication and characterization of silicon tunneling structures. GRA

N88-16931# Salford Univ. (England). Dept. of Chemistry.
INTERFACIAL EFFECTS IN THIN LI/PEO CELLS AT ROOM TEMPERATURE
J. R. Upton, K. A. Murgesamoorthi, J. R. Owen, P. J. Tufton, and J. D. Benjamin 26 Oct. 1987 7 p Prepared in cooperation with the Royal Signals and Radar Establishment, Malvern, United Kingdom
(Contract N00014-85-G-0185)
(AD-A186974; TR-2) Avail: NTIS HC A02/MF A01 CSCL 10C

Discharge characteristics and impedance measurements have been obtained for thin film cells comprising lithium and V2O5 electrodes and a (PEO)8 LiClO4 electrolyte, and for diagnostic cells with nickel counter electrodes. Results indicate that a reaction layer exists at the Li electrode and that this represents the main limitation to rate capability of the cells at room temperature. GRA

N88-16932# Massachusetts Inst. of Tech., Cambridge. Lab. for Computer Science.
SINGLE-LAYER WIRE ROUTING
F. M. Maley Aug. 1987 363 p
(Contract N00014-80-C-0622)
(AD-A186990; MIT/LCS/TR-403) Avail: NTIS HC A16/MF A01 CSCL 09A

This dissertation concerns the problem of routing wires on a single layer of an integrated circuit or printed circuit board, starting from a sketch of the layer. A sketch specifies the positions of layout features and the topology of the interconnecting wires. Efficient algorithms are presented that: (1) determine whether a sketch is routable, and (2) produce for a routable sketch a proper routing that minimizes both individual and total wire length. Both algorithms run in time O(sq n log n) on input of size n, and both are simple to implement. They can be adapted to a variety of wiring models, and they subsume most of the polynomial-time algorithms in the literature for single-layer routing and routability testing. The algorithms are based on two theorems concerning the routings of a sketch. One states that a sketch is routable if and only if for each cut between fixed features, the total amount of wiring forced to cross the cut is no greater than the length of the cut. The second theorem states that every routable sketch has a routing that simultaneously minimizes the length of every wire, and that it characterizes the wires in this routing. To formalize and prove these theorems, a rich mathematical theory of single-layer wire routing is developed. GRA

N88-16933# Los Alamos National Lab., N. Mex.
TEST RESULTS ON DUAL RESONANT POWER SUPPLY WITH FLAT TOP AND FLAT BOTTOM CURRENT
E. Schneider 1987 4 p Presented at the Particle Accelerator Conference, Washington, D.C., 16 Mar. 1987
(Contract W-7405-eng-36)
(DE87-007506; LA-UR-87-1068; CONF-870302-40) Avail: NTIS HC A02

An alternative to the linear increase and decrease of current through the magnets of a circular ring is a dual resonant frequency power supply that can maintain flat bottom and flat top currents in the magnets. This paper deals with the experimental results obtained by operating a model of such a power supply and observing the results of changes in various parameters. The model is first operated in a single-pulse mode starting from an equilibrium dc condition of the magnet flat bottom current. The effects of the circuit losses and the method of replacing energy in the system will be presented. When operating the power supply in continuous mode, it will be shown that the magnet flat bottom current and magnet flat top current can be controlled. DOE

N88-16934# Brandeis Univ., Waltham, Mass.
SLIDING CHARGE DENSITY WAVES AND RELATED PROBLEMS Final Report, 1 Nov. 1983 - 31 Mar. 1987
L. Sneddon 31 Mar. 1987 40 p
(Grant AF-AFOSR-0014-84)
(AD-A186720; AFOSR-87-1373TR) Avail: NTIS HC A03/MF A01 CSCL 09C

From the publications (in many cases from the Figures) it is seen that incommensurate chains give a surprisingly good account of the following dozen measurements: both components of complex ac conductivities as functions of field and frequency, in both metallic and semiconducting charge density wave (CDW) materials; dc characteristics; scaling of ac and dc conductivities; elastic properties - Young's Modules and Q-factor as functions of voltage; bulk oscillations; and both amplitude and phase of both the second and third order mixing properties. In addition, incommensurate chains have been seen to exhibit complete mode locking over the entire range of dc fields and external frequencies. GRA

N88-16935# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
RADIANT POWER DEGRADATION OF SILICON-DOPED GALLIUM ARSENIDE AND GALLIUM ALUMINUM ARSENIDE INFRARED LIGHT-EMITTING DIODES M.S. Thesis
William N. Resimont May 1987 75 p
(AD-A186726; AFIT/CI/NR-87-67T) Avail: NTIS HC A04/MF A01 CSCL 20L

This work investigates the use of the capacitance-voltage (C-V), current-voltage (I-V), and radiant power-current-voltage (P-I-V) diode characteristics as a means of modeling the general radiant power degradation of silicon-doped gallium arsenide and gallium aluminum arsenide (GaAs:Si, GaAlAs:Si) infrared light emmiting diodes. The procedure consists of measuring the initial characteristics, stressing with various operating current densities at room temperature, then periodically repeating the measurements. Control diodes that are not stressed are tested to determine the precision of the measuring apparatus and the normal variations in diode behavior. GRA

N88-16936# Bristol Univ. (England). Dept. of Electrical Engineering.
DIGITAL CONTROL OF HIGH FREQUENCY PULSE-WIDTH MODULATED INVERTERS Ph.D. Thesis
Michael John Stevens Aug. 1985 234 p Sponsored by UK Science and Engineering Research Council, and Mullard Ltd.
(ETN-87-90711) Avail: NTIS HC A11/MF A01

The effect of word length on the hormonic content of pulse width modulated (PWM) waveform generators, and voltage control in high carrier frequency PWM waveform generators were studied. Eight and four bit microprocessor-based PWM waveform generators operating silently with a 20 kHz carrier were developed. The PWM output of each generator is determined by voltage, modulating frequency, and carrier frequency. Eight bit systems are capable of generating virtually pure sinusoids from 0 to greater than 2 kHz and can form general purpose, PWM waveform generators suitable for driving a variety of inverter power switches. An inverter power stage with a selection of MOSFET gate drive circuits, depending upon the switching characteristics required of the power devices, was constructed. Author (ESA)

N88-16937# Bristol Univ. (England). Dept. of Electrical and Electronic Engineering.
THE THEORY AND IMPLEMENTATION OF A HIGH QUALITY PULSE WIDTH MODULATED WAVEFORM SYNTHESISER APPLICABLE TO VOLTAGE FED INVERTERS Ph.D. Thesis
Kim Nigel Lower Mar. 1985 332 p Sponsored by United Kingdom Science and Engineering Council
(ETN-87-90712) Avail: NTIS HC A15/MF A01

Modulation processes associated with the digital implementation of pulse width modulation (PWM) switching strategies were examined. A software package based on a portable turnkey structure is presented. Waveform synthesizer implementation techniques are reviewed. A three phase PWM waveform synthesizer

for voltage fed inverters was realized. It is based on a constant carrier frequency of 18 kHz and a regular sample, single edge, asynchronous PWM switching scheme. With high carrier frequencies, it is possible to utilize simple switching strategies and as a consequence, many advantages are highlighted, emphasizing the importance to industrial and office markets.
Author (ESA)

N88-16938# Fighting Vehicles Research and Development Establishment, Chertsey (England). Electrical Branch.
FAILURE OF FILAMENT LAMPS SUBJECTED TO VIBRATION WITH SPECIAL REFERENCE TO THE 26 VOLT 5 WATT TANK LAMP Interim Report
A. E. Hampton and J. E. Lay [1987] 43 p
(Contract G29/EL-78E)
(EL-135; BR83448; ETN-88-91518) Copyright Avail: NTIS HC A03/MF A01

Vibration tests and road tests were carried out on filament lamps for tanks. All failed due to manufacturing defects and stresses produced when the vibration frequency of the vehicle passes through the resonant frequencies of the lamp's internal structure.
ESA

N88-16939# Technische Univ., Berlin (West Germany). Fachbereich Elektrotechnik.
THEORETICAL AND EXPERIMENTAL INVESTIGATIONS ON A LINEAR, PERMANENTLY EXCITED STEPPING MOTOR Ph.D. Thesis [THEORETISCHE UND EXPERIMENTELLE UNTERSUCHUNGEN AN EINEM LINEAREN, PERMANENTERREGTEN SCHRITTMOTOR]
Lutz Neubauer 1987 124 p In GERMAN
(ETN-88-91061) Avail: NTIS HC A06/MF A01

A drive for a linear, digitally controlled motor whose thrust comes from the high energy of a rare-earth magnet, was developed. Samarium-cobalt magnets and neodymium-iron-boron magnets were used. The practically fixed magnetization of these materials allows a potential-theory treatment of their fields in an unslotted space. The exciting field induction was determined via the boundary conditions. The effect of a slot was determined by the calculation of the slot potential using the Schwarz-Christoffel transformation. The motor force was calculated from the exciting field induction. Superposed on it is a rest force whose magnitude depends on the slot potential. Measurements confirm the calculations and illustrate the expected force increase when using the neodymium-iron-boron magnet.
ESA

N88-16940# Farran Technology Ltd., Ballincollig (Ireland).
COMPARATIVE INVESTIGATION OF HETERODYNE MIXERS AT 1000 GHz Final Report
Paris, France ESA Apr. 1987 211 p
(Contract ESTEC-5598/83-NL-PR)
(FTL-068627; ESA-CR(P)-2465; ETN-88-91418) Avail: NTIS HC A10/MF A01

A Schottky-barrier diode mixer and a Josephson junction mixer were compared at 1000 GHz. Two local oscillators were available, a carcinotron at 845 to 920 GHz and a laser at 890 GHz. The results at a local oscillator frequency of 890 GHz are quoted. The receiver noise temperatures of the complete receivers are very much the same, i.e., DSB T(R) = 15,000 K. The LO power required to achieve this receiver noise temperature is 1 micro W for the Josephson mixer and 750 micro W for the Schottky mixer. The LO power required by the Josephson mixer is still regarded as high, as it was expected to be 10 nW. The required operating temperature for the Josephson receiver is 4 K, 105 K for the Schottky receiver. The noise temperatures of the two cooled receivers are approximately the same and the mixer noise temperature of the Josephson mixer is slightly lower than that for the diode mixer. The mixer conversion loss of the Josephson mixer is 6 dB higher than that for the diode mixer. The receivers achieve comparable sensitivities in spite of the differences in conversion loss due to a compensating imbalance in the noise figures of the IF amplifiers.
ESA

N88-16941# Florence Univ. (Italy). Dipartimento di Ingegneria Elettronica.
MULTICARRIER DEMODULATOR DESIGN, VOLUME 1 Final Report
E. DelRe, P. L. Emiliano, R. Fantacci, V. Piloni, and R. Viola (Italspazio, Rome, Italy) Paris, France ESA Dec. 1986 434 p
(Contract ESTEC-6096/84-NL-GM(SC))
(ESA-CR(P)-2468-Vol-1; ETN-88-91419) Avail: NTIS HC A19/MF A01

Designs of digitally implemented multicarrier demodulators (MCD) operating at 9.6, 64, and 2048 kbps for mobile, fixed and mobile, and fixed communication respectively were selected. Specifications for the implementation of laboratory test prototypes and for custom VLSI versions were derived. All the proposed solutions for the MCD can be implemented by available technology in the experimental and VLSI versions with acceptable complexity and power consumption. Block approaches have advantages over per channel structure as to complexity and power consumption. Choice of the structure to be implemented should be based mainly on considerations such as structure modularity, flexibility, reliability, and matching of the MCD structure to the per channel system operation. Close integration of demultiplexer and demodulator operations, in order to reduce the MCD complexity, mainly for the 9.6 Kbps and 2048 Kbps cases; and the possibility of achieving on-board synchronization of individual channel clocks, thus eliminating the necessity of having a clock recovery circuit for each channel, should be studied.
ESA

N88-16942# Florence Univ. (Italy). Dipartimento di Ingegneria Elettronica.
MULTICARRIER DEMODULATOR DESIGN. VOLUME 2: EXECUTIVE SUMMARY
E. DelRe, P. L. Emiliani, R. Fantacci, V. Piloni, and R. Viola (Italspazio, Rome, Italy) Paris, France ESA Dec. 1986 37 p
(Contract ESTEC-6096/84-NL-GM(SC))
(ESA-CR(P)-2468-Vol-2; ETN-88-91420) Avail: NTIS HC A03/MF A01

Designs of digitally implemented multicarrier demodulators (MCD) operating at 9.6, 64, and 2048 kbps for mobile, fixed and mobile, and fixed communication respectively were selected. Specifications for the implementation of laboratory test prototypes and for custom VLSI versions were derived. All the proposed solutions for the MCD can be implemented by available technology in the experimental and VLSI versions with acceptable complexity and power consumption. Block approaches have advantages over perchannel structure as to complexity and power consumption. Choice of the structure to be implemented should be based mainly on considerations such as structure modularity, flexibility, reliability, and matching of the MCD structure to the per channel system operation. Close integration of demultiplexer and demodulator operations, in order to reduce the MCD complexity, mainly for the 9.6 Kbps and 2048 Kbps cases; and the possibility of achieving on-board synchronization of individual channel clocks, thus eliminating the necessity of having a clock recovery circuit for each channel, should be studied.
ESA

N88-16943# Royal Signals and Radar Establishment, Malvern (England).
GaAs VARACTOR DIODE MMIC FABRICATION TECHNOLOGY
B. T. Hughes, J. T. Parker, and J. Woodward Mar. 1987 62 p
(RSRE-MEMO-4022; BR102865; ETN-88-91537) Copyright Avail: NTIS HC A04/MF A01

Design criteria and techniques were developed to fabricate a monolithic low series resistance N on N(+) GaAs varactor diode and the associated microwave circuit. A high resolution polyimide patterning process developed for this device is described. Experiments to establish the practical design rules for the polyimide dielectric on chip capacitors are summarized. The seven level mask set and associated processing are presented, and the yield obtained on several wafers is discussed. The processing technology was successfully transferred to industry.
ESA

N88-16944# Research Inst. of National Defence, Linkoeping (Sweden).
MICROWAVE TUBES: LITERATURE STUDY NO. 8 COMPRISING THE YEAR 1986
Lennart Lundgren Oct. 1987 132 p
(FOA-C-30467-3; ISSN-0347-3708; ETN-88-91674) Avail: NTIS HC A07/MF A01; Research Institute of National Defence, Stockholm, Sweden KR 50

Literature on generation/amplification of microwaves (UHF to submillimeter waves) was reviewed. Conventional microwave tubes including gyrotrons, as well as less conventional tubes like cupstrons, orotrons, and vircators are covered. Free electron masers and other concepts of generating/amplifying microwave power indicate the state of the art and the trends of future development. Electron guns, cathodes, and electron beams up to GW-level are also included (639 references). ESA

N88-16945*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
IRAC TEST REPORT. GALLIUM DOPED SILICON BAND 2: READ NOISE AND DARK CURRENT
Gerald Lamb, Peter Shu, John Mather, Audrey Ewin, and Jeffrey Bowser (Science Systems and Applications, Inc., Lanham, Md.) Jan. 1987 68 p
(NASA-TM-87813; Rept-87B0156; NAS 1.15:87813) Avail: NTIS HC A04/MF A01 CSCL 09A

A direct readout infrared detector array, a candidate for the Space Infrared Telescope Facility (SIRTF) Infrared Array Camera (IRAC), has been tested. The array has a detector surface of gallium doped silicon, bump bonded to a 58x62 pixel MOSFET multiplexer on a separate chip. Although this chip and system do not meet all the SIRTF requirements, the critically important read noise is within a factor of 3 of the requirement. Significant accomplishments of this study include: (1) development of a low noise correlated double sampling readout system with a readout noise of 127 to 164 electrons (based on the detector integrator capacitance of 0.1 pF); (2) measurement of the readout noise of the detector itself, ranging from 123 to 214 electrons with bias only (best to worst pixel), and 256 to 424 electrons with full clocking in normal operation at 5.4 K where dark current is small. Thirty percent smaller read noises are obtained at a temperature of 15K; (3) measurement of the detector response versus integration time, showing significant nonlinear behavior for large signals, well below the saturation level; and (4) development of a custom computer interface and suitable software for collection, analysis and display of data. Author

N88-16946# Electricity Council Research Centre, Capenhurst (England).
SOME INVESTIGATIONS OF ELECTRICAL DISCHARGES AT THE SURFACES OF SOLID CATHODES IMMERSED IN AQUEOUS ELECTROLYTE SOLUTIONS
M. J. Copsey Dec. 1986 63 p
(PB87-168209; ECRC/M-2084) Avail: NTIS HC E06/MF E06 CSCL 09C

The visual and spectroscopic characteristics of cathodic submerged electrolytic arc discharges are described. The results of photographic observations and electrical measurements are discussed in relation to a model of the process in which current is transferred through a thin, insulating vapor film surrounding the cathode by means of a time varying distribution of short-lived arc discharges between the cathode surface and the vapor/electrolyte boundary. Author

N88-16738# European Space Agency, Paris (France). Spacecraft Power Supplies Div.
THE EUROPEAN SPACE BATTERY TEST CENTER
H. J. Young and D. Goudot *In its* ESA Bulletin No. 10 Aug. 1977 p 60-65 (For primary document see N88-16728 09-12)
Avail: NTIS HC A05/MF A01

N88-17222*# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio.
INTERCHANGE OF ELECTRONIC DESIGN THROUGH VHDL AND EIS
Richard M. Wallace *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 119-124 (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 22B

34 FLUID MECHANICS AND HEAT TRANSFER

Includes boundary layers; hydrodynamics; fluidics; mass transfer; and ablation cooling.

For related information see also *02 Aerodynamics* and *77 Thermodynamics and Statistical Physics.*

N88-16947# Princeton Univ., N. J. Dept. of Mechanical and Aerospace Engineering.
[NUMERICAL SIMULATION OF HEAT TRANSFER TURBULENCE, VOLUME 4] Final Report, 1 Oct. 1984 - 30 Nov. 1986
Steven A. Orszag May 1987 67 p
(Contract F49620-85-C-0026; AF Proj. 2307)
(AD-A185132; AFOSR-87-1349TR-Vol-4) Avail: NTIS HC A04/MF A01 CSCL 01B

The major results of this report on numerical simulation of heat transfer turbulence are as follows: (1) the development and application of the renormalization group method to the calculation of fundamental constants of turbulence, the construction of turbulence transport models, and large-eddy simulations; (2) the application of PNG methods to turbulent heat transfer through the entire range of experimentally accessible Reynolds numbers; (3) the discovery that high Reynolds number turbulent flows tend to act as if they had weak nonlinearities, at least when viewed in terms of suitable quasi-particles; (4) the further analysis of secondary instability mechanisms in free shear flows, including the role of these instabilities in chaotic, 3-D free shear flows; (5) the further development of numerical simulations of turbulent spots in wall bounded shear flows; and (6) the study of cellular automata for the solution of For individual titles, see N88-16948 through N88-16949.

N88-16948# Princeton Univ., N. J.
WEAK INTERACTIONS AND LOCAL ORDER IN STRONG TURBULENCE
Victor Yakhot, Steven A. Orszag, Alexander Yakhot, Raj Panda, Uriel Frisch, and Robert H. Kraichnan (Kraichnan, Robert H., Los Alamos, N. Mex) *In its* Numerical Simulation of Heat Transfer Turbulence, Volume 4, May 1987 17 p (For primary document see N88-16947 09-34)
Avail: NTIS HC A04/MF A01 CSCL 01B

Data from simulations of channel flow and decay of homogeneous turbulence indicate anomalously strong correlation of velocity and vorticity directions (local Beltramization) in band-filtered velocity fields when the band consists of a thin cigar shape in mode space (whose physical space representation is as an array of pancake eddies). Spherical shells or other broad bands in mode space do not seem to exhibit the effect. Author

N88-16949# Princeton Univ., N. J. Applied and Computational Mathematics.
AN EFFICIENT METHOD FOR COMPUTING LEADING EIGENVALUES AND EIGENVECTORS OF LARGE ASYMMETRIC MATRICES
I. Goldhirsch, Steven A. Orszag, and B. K. Maulik *In its* Numerical Simulation of Heat Transfer Turbulence, Volume 4, May 1987 44 p (For primary document see N88-16947 09-34)
Avail: NTIS HC A04/MF A01 CSCL 01B

An efficient method for computing a given number of leading eigenvalues (i.e., having the largest real parts) and the corresponding eigenvectors of a large asymmetric matrix M is presented. The method consists of three main steps. The first is a filtering process in which the equation x dot = Mx is solved for an arbitrary initial condition x(0) yielding: x(t) = e sup Mt x (0). The second step is the construction of (n + 1) linearly independent vectors v sub m = M sup m x, 0 less than or = m less than or = n or v sub m = e sup mMtau x (tau being a short time interval). By construction, the vectors v sub m are combinations of only a small number of leading eigenvectors of M. The third step consists of an analysis of the vectors (v sub m) that yields the eigenvalues and eigenvectors. The proposed method has been tested on several systems. Results pertaining to the Orr-Sommerfeld equation are presented. The method should be useful for many computations in which present methods are too slow or necessitate excessive memory. In particular, it is believed well suited for hydrodynamic and mechanical stability investigations. Author

N88-16950# Naval Postgraduate School, Monterey, Calif.
INDIRECT MEASUREMENT OF LOCAL CONDENSING HEAT-TRANSFER COEFFICIENT AROUND HORIZONTAL FINNED TUBES M.S. Thesis
Donald J. Lester, Jr. Sep. 1987 127 p
(AD-A186929) Avail: NTIS HC A07/MF A01 CSCL 20M

Heat transfer measurements were made for condensation of steam on three finned tubes with rectangular section fins. These tubes have a fin thickness and fin height of 1.0 mm and fin spacings of 0.5, 1.0 and 1.5 mm. Data were taken by insulating both the inner and outer surfaces up to 5 or 6 angular portions, including 0, 30, 60, 90, 150, 210 degrees, of the top portion of each tube. The measured average heating transfer coefficients for the unblanked portion of the tube were processed to yield both the local and average heat transfer performance as a function of the angle measured from the top of the tube using a third-order polynomial. The results show that the average enhancement for the fin spacings of 0.5, 1.0 and 1.5 mm were 2.5, 3.0 and 3.1, respectively, for the atmospheric-pressure condition. And they were 1.8, 2.3 and 2.4 for the low-pressure condition. The local enhancements at the top of tubes were 5.2 and 3.8 for s = 0.5 mm, 6.6 and 4.8 for s = 1.0 mm, and 6.6 and 5.5 for s = 1.5 mm at atmospheric and low pressures, respectively. Filmwise, Condensate retention, Heat transfer coefficient, Finned tubes. GRA

N88-16951# Naval Postgraduate School, Monterey, Calif.
FLOW FIELD MEASUREMENTS USING HOTWIRE ANEMOMETRY M.S. Thesis
Gregory J. Doremus Sep. 1987 105 p
(AD-A187029) Avail: NTIS HC A06/MF A01 CSCL 01A

A computer controlled data acquisition system utilizing hotwire anemometry has been designed, built, and installed at the Low Speed Wind Tunnel Facility. All relevant wind tunnel data is obtained by the use of a computer guided data acquisition system. Two computer programs were written to coordinate hotwire system calibration with hotwire experimentation. An experiment, Wake Velocity Profile Analysis and Drag Coefficient Measurement of an Airfoil, was used as a vehicle to test the system. The final output of the data acquisition system, including graphical information, compared favorably with previous results from an older data acquisition system already in use. Drag coefficient output compared very favorably to data supplied by the National Advisory Committee on Aeronautics. GRA

N88-16952# California Inst. of Tech., Pasadena. Div. of Engineering and Applied Science.
EXPERIMENTAL AND THEORETICAL STUDY ON CAVITATION INCEPTION AND BUBBLY FLOW DYNAMICS. PART 1: DESIGN, DEVELOPMENT AND OPERATION OF A CAVITATION SUSCEPTIBILITY METER. PART 2: LINEARIZED DYNAMICS OF BUBBLY AND CAVITATING FLOWS WITH BUBBLE DYNAMICS EFFECTS Ph.D. Thesis
Luca DAgostino May 1987 325 p
(Contracts N00014-83-K-0506; N00167-85-K-0165)
(AD-A187133; ENG-183-16-Pt-1-Pt-2) Avail: NTIS HC A14/MF A01 CSCL 13J

This theses presents the design, development and operations of a Cavitation Susceptibility Meter based on the use of a venturi tube for the measurement of the content of active cavitation nuclei in water samples. The pressure at the venturi throat is determined from the upstream pressure and the local flow velocity without corrections for viscous effects because the flow possesses a laminar potential core in all operational conditions. The detection ov cavitation and the measurement of the flow velocity are carried out optically. The apparatus comprises a Laser Doppler Velocimeter for the measurement of the flow velocity and the detection of cavitation, a custom-made electronic Signal Processor for real time generation and temporary storage of the data and a computerized system for the final acquisition and reduction of the collected data. The results of application of the Cavitation Susceptibility Meter to the measurement of the water quality of the tap water samples are presented. The results of an investigation are presented on the linearized dynamics of two-phase bubbly flows with the inclusion of bubble dynamics effects. Two flow configurations have been studied: the time dependent one-dimensional flow of a spherical bubble cloud subject to harmonic excitation of the far field external pressure and the steady state two-dimensional flow of a bubbly mixture on a slender profile of arbitrary shape. GRA

N88-16953# Naval Ship Research and Development Center, Bethesda, Md.
STEADY SHIP WAVES AT LOW FROUDE NUMBERS, PART 2 Final Report
Francis Noblesse Dec. 1986 35 p
(AD-A176805; DTNSRDC-86/078-Pt-2) Avail: NTIS HC A03/MF A01 CSCL 20D

A low-Froude number asymptotic expansion for the far-field wave-amplitude function defined within the Neumann-Kelvin theoretical framework is presented. This asymptotic expansion provides a simple analytical approximation defined explicitly in terms of the geometrical characteristics of the ship hull and the disturbance velocity vector. The low-Froude number analysis presented shows that the wave resistance and the far-field pattern of a ship strongly depend on the shape of the hull, notably the presence of flare and the shape of the waterline at the bow and the stern. In particular, the analysis predicts that the nondimensional wave-resistance coefficient is O(F sup 2), where F is the Froude number, for a ship form with a region of flare, O(F sup 4) for a stopform that is wall sided everywhere O(F sup 4) for a ship form that is wall sided everywhere and has either a bow or a stern (or both) that is neither cusped nor round, and O (sup 6) for a wall-sided ship form with both bow and stern that are either cusped or round. Author

N88-16954# Pittsburgh Univ., Pa. Dept. of Physics and Astronomy.
STUDY OF PATTERN FORMATION AT LIQUID INTERFACES Progress Report, Nov. 1986 - Oct. 1987
James V. Maher Oct. 1987 8 p
(Contract DE-FG02-84ER-45131)
(DE88-001399; DOE/ER-45131/5) Avail: NTIS HC A02/MF A01

This paper summarizes the work done on the following topics at the University of Pittsburgh: the behavior of a tip-splitting, viscous-fingering system and the role of interfacial noise in pattern formation on planar interfaces; the search for instability on a quenched liquid interface; and binary liquid gels and polymer solutions. DOE

N88-16955# Argonne National Lab., Ill. Materials and Components Technology Div.
A REVIEW OF TWO-PHASE FLOW-INDUCED VIBRATION
S. S. Chen Aug. 1987 54 p

(Contract W-31109-eng-38)
(DE88-001955; ANL-87-28) Avail: NTIS HC A04/MF A01

Two-phase flow exists in many shell-and-tube heat exchangers and power generation components. The flowing fluid is a source of energy that can induce small-amplitude subcritical oscillations and large-amplitude dynamic instabilities. In fact, many practical system components have experienced excessive flow-induced vibrations. To prevent unacceptable flow-induced vibration, we must understand excitation mechanisms, develop analytical and experimental techniques, and provide reliable design guidelines. Thus, we are conducting a comprehensive program to study structural vibration in components subjected to two-phase flow. This report reviews the current understanding of vibration of circular cylinders in quiescent fluid, crossflow, and axial flow, with emphasis on excitation mechanisms, mathematical models, and available experimental data. A unified theory is presented for cylinders oscillating under different flow conditions. Based on the theory, future research needs are outlined. DOE

N88-16956*# Nebraska Univ., Lincoln. Lab. for Electro-Optical Measurements.
COMPARISON OF UNL LASER IMAGING AND SIZING SYSTEM AND A PHASE/DOPPLER SYSTEM FOR ANALYZING SPRAYS FROM A NASA NOZZLE Final Report, 1 Apr. 1985 - 19 Aug. 1987
Dennis R. Alexander 14 Feb. 1988 139 p
(Grant NAG3-634)
(NASA-CR-182437; NAS 1.26:182437) Avail: NTIS HC A07/MF A01 CSCL 20D

Aerosol spray characterization was done using a P/DPA and a laser imaging/video processing system on a NASA MOD-1 air-assist nozzle being evaluated for use in aircraft icing research. Benchmark tests were performed on monodispersed particles and on the NASA MOD-1 nozzle under identical laboratory operating conditions. The laser imaging/video processing system and the P/DPA showed agreement on calibration tests in monodispersed aerosol sprays of + or - 2.6 microns with a standard deviation of + or - 2.6 microns. Tests were performed on the NASA MOD-1 nozzle on the centerline and radially at one-half inch increments to the outer edge of the spray plume at a distance two feet (0.61 m) downstream from the exit of the nozzle. Comparative results at two operating conditions of the nozzle are presented for the two instruments. For the first case, the deviation in arithmetic mean diameters determined by the two instruments was in a range of 0.1 to 2.8 microns, and the deviation in Sauter mean diameters varied from 0 to 2.2 microns. Operating conditions in the second case were more severe which resulted in the arithmetic mean diameter deviating from 1.4 to 7.1 microns and the deviation in the Sauter mean diameters ranging from 0.4 to 6.7 microns.
Author

N88-16957# Cornell Univ., Ithaca, N.Y.
DYNAMICAL CHARACTERISTICS OF WEAK TURBULENCE Final Report
John Guckenheimer Aug. 1987 4 p
(Grant AF-AFOSR-0157-85)
(AD-A186724) Avail: NTIS HC A02/MF A01 CSCL 20D

This research covered global bifurcations in planar vector fields. In particular, codimension two bifurcations involving a simple saddle point was constructed together with related results applied to Hilbert's 16th problem. Also investigated were dynamical systems with symmetry groups. Notable was the discovery of heteroclinic cycles that are structurally stable within the class of symmetric systems. This has implications for the behavior of the K-S eg and turbulence modelling. Finally some work on ID maps was initiated. Preliminary results on the measure of an attracting set has implications for the famous Henon map. Nine papers were written. GRA

N88-16958# Lehigh Univ., Bethlehem, Pa. Dept. of Mechanical Engineering and Mechanics.
UNSTEADY BEHAVIOR OF THREE-DIMENSIONAL VORTICES RELEVANT TO TURBULENT BOUNDARY LAYERS Annual Technical Report, Jul. 1986 - Jul. 1987
C. R. Smith and J. D. A. Walker Aug. 1987 29 p
(Contract F49620-85-C-0108)
(AD-A186767; AFOSR-87-1536TR) Avail: NTIS HC A03/MF A01 CSCL 20D

The recent accomplishments are reviewed for a research program employing combined analytical-experimental techniques to study the three dimensional characteristics and behavior of vortex motions associated with the turbulence production process in turbulent boundary layers. Progress is described in the development of a new image processing technique which allows the derivation of quantitative data from flow visualization images. The method is used to search for the role of hairpin vortices in the turbulence production process. In the analytical portion of the study, calculations have been carried out to compute the evolution of a hairpin vortex in a shear flow; the interaction of a pair of hairpins has been examined as well as the viscous response at a wall due to the motion of a hairpin vortex. Comparison of these computer simulations with the experimental studies is very encouraging. Computations for the evolving flow between wall layer streaks during a typical cycle in the wall layer of a turbulent boundary layer have also been carried out; these studies show two possible routes to breakdown of the wall layer flow leading to the production process. GRA

N88-16959# Technische Univ., Munich (West Germany). Lehrstuhl fuer Stroemungsmechanik.
NUMERICAL CALCULATION OF TURBULENT RECIRCULATING FLOWS Thesis [NUMERISCHE BERECHNUNG TURBULENTER REZIRKULIERENDER STROEMUNGEN]
Heinrich Werner 1984 147 p In GERMAN
(TUM-LSM-84/29; ETN-87-90360) Avail: NTIS HC A07/MF A01

The standard K-epsilon turbulence model was built into a calculation program for the simulation of three-dimensional laminar flows. The discretization of general transport phenomena, the transport equations, and the boundry conditions are presented. In the numerical calculation of turbulent flows, on the basis of the time-averaged Navier-Stokes equations (Reynolds equations) and using a turbulence model consisting of two additional transport equations, the choice of the difference methods remains free. In order to evaluate the simulation quality, the turbulent flow was calculated on a cavity and in channel with retracted stage and transverse rib, respectively. The comparison of the results with experiments and other numerical investigations shows varying agreement. Author (ESA)

N88-16960# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (West Germany). Abteilung fuer Numerische Stroemungsmechanik.
NUMERICAL SIMULATION OF THE INTERACTION OF PRESSURE WAVES WITH LAMINAR AND TURBULENT BOUNDARY LAYERS
Heinrich Reister Dec. 1986 105 p In GERMAN; ENGLISH summary Report will also be announced as translation (ESA-TT-1089)
(DFVLR-FB-87-18; ISSN-0171-1342; ETN-88-91375) Avail: NTIS HC A06/MF A01; DFVLR, Cologne, Federal Republic of Germany DM 33.50

The interaction of upstream moving pressure waves with laminar and turbulent boundary layers was investigated. The unsteady, compressible Navier-Stokes equations were solved using a Runge-Kutta finite volume method. The numerical solutions for simplified physical models, e.g., the formation of an acoustic boundary layer and the steepening of linear waves to a sawtooth pattern, were compared with analytical solutions, showing good agreement. The numerical solution of the pressure-wave boundary-layer interaction demonstrates under which conditions

reverse flow areas occur in the boundary layer and what their structure is. ESA

N88-16961# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (West Germany). Inst. fuer Experimentelle Stroemungsmechanik.
THE VISCOUS FLOW ON SURFACES WITH STREAMWISE RIBLETS
Manfred Barteriwerfer and Dietrich W. Bechert Mar. 1987 97 p In GERMAN; ENGLISH summary Report will also be announced as translation (ESA-TT-1091)
(DFVLR-FB-87-21; ISSN-0171-1342; ETN-88-91377) Avail: NTIS HC A05/MF A01; DFVLR, Colog ne, Federal Republic of Germany DM 27

The viscous sublayer of a turbulent boundary layer on a surface with riblets was calculated. Only the mean flow constituent was considered. Using conformal mapping viscous flow on various riblet configurations was determined, including sawtooth profiles and U-shaped groove configurations. The ridges of the riblets are either sharp-edged or rounded. The distance between origin of the velocity profile and ridge tip is called the protrusion height (hp). This quantity was also measured in electrolytic simulation experiments. The decreased turbulent drag of riblet surfaces is caused by hampering the fluctuating cross flow. The efficiency of the riblets depends on their protrusion height. However, the protrusion height cannot be increased beyond 22 percent of the lateral rib spacing. This limits the drag reduction potential of riblet surfaces. ESA

N88-16962# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Hardthausen (West Germany). Abteilung Brennertechnologie.
CALCULATION ON FILM PREPARATION AND FILM MOTION OF A SWIRL ATOMIZER
Tom Schork (Heidelberg Univ., West Germany) and Zoltan Farago May 1987 83 p In GERMAN; ENGLISH summary Report will also be announced as translation (ESA-TT-1096)
(DFVLR-FB-87-25; ISSN-0171-1342; ETN-88-91448) Avail: NTIS HC A05/MF A01; DFVLR, Cologne, Fed. Republic of Germany DM 31

A concept for the calculation of basic hydraulic integral variables of a simplex swirl atomizer, such as average mass flow, film thickness, and angle of the hollow conical sheet, is introduced. The conservation of angular and total momemtum is assumed. Total momemtum is described by the Bernouilli equation assuming an inviscid vortex. For vortex flow, in addition to the conservation equations, further stability criteria, needed for an unequivocal solution, are presented. The motion of the hollow conical street was calculated assuming an equilibrium between surface and inertia forces, and using the time-averaged values of emergence mass flow and film thickness. Possibilities to improve the calculation of return flow swirl atomizers and to consider viscosity effects are indicated. ESA

N88-16963# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (West Germany). Inst. fuer Experimentelle Stroemungsmechanik.
THE FLOW DOWNSTREAM OF SCREENS AND THE FORMATION OF LONGITUDINAL VORTICES IN THE STAGNATION POINT FLOW Ph.D. Thesis - Goettingen Univ., Fed. Republic of Germany
Jan Boettcher Jul. 1987 112 p In GERMAN; ENGLISH summary
(DFVLR-FB-87-27; ISSN-0171-1342; ETN-88-91449) Avail: NTIS HC A06/MF A01; DFVLR, Cologne, Fed. Republic of Germany DM 39.50

The flow downstream of sieves and arrays of parallel rods, as well as the longitudinal vortices in the stagnation region of a circular cylinder were investigated in a water towing tank. The hydrogen bubble method was employed for flow visualization. The measurements show that jets emerging from the screen pores coalesce until a stable condition is reached. The results mainly depend on sieve geometry. Vortex structures are only found if finite disturbances are produced in the oncoming flow. Flow instability on an oscillating cylinder with a superimposed flow perpendicular to the oscillation was characterized. ESA

N88-16964# Technische Hogeschool, Delft (Netherlands).
HEAT TRANSFER FROM IMPINGING FLAME JETS Ph.D. Thesis
Theodorus Hendrikus vanderMeer 1987 190 p
(ETN-88-91610) Avail: NTIS HC A09/MF A01

The influence of turbulence on heat transfer and on the nonuniformity of the heat flux distribution to an object in a furnace was studied. Heat transfer from a premixed flame jet impinging perpendicularly on a flat plate was examined. The flow structure and heat transfer of impinging flame jets as well as impinging isothermal jets from two rapid heating burners were measured. Static pressure in the stagnation region was measured to find the radial velocity gradient just outside the boundary layer in the vicinity of the stagnation point. Using a numerical model impinging isothermal jets were simulated. It is shown that from isothermal measurements and from measurements of the radial velocity gradient near the stagnation point that a first approximation of the heat transfer from impinging premixed flame jets can be made. ESA

N88-16965# Technische Hogeschool, Delft (Netherlands).
NUMERICAL AND PHYSICAL ASPECTS OF LARGE EDDY SIMULATION OF TURBULENT FLOWS Ph.D. Thesis
Marco Lafeber 1987 150 p
(ETN-88-91611) Avail: NTIS HC A07/MF A01

The basic equations of large eddy simulation are recalled, and large eddy simulation near solid walls is reviewed. Computing methods for velocity and pressure fields are outlined. Numerical experiments on channel flow are summarized. ESA

N88-16966# Aeronautical Research Inst. of Sweden, Stockholm. Dept. of Aerodynamics.
NAVIER-STOKES SOLUTIONS FOR LAMINAR INCOMPRESSIBLE FLOW OVER A NACA 0012 AIRFOIL AND A BACKWARD FACING STEP
Peter Eliasson 19 Aug. 1987 49 p Sponsored by the Swedish Board for Technical Development
(FFA-TN-1987-50; ETN-88-91668) Avail: NTIS HC A03/MF A01

For the solution of the incompressible Navier-Stokes equation, an explicit Runge-Kutta finite-volume solver was created. The gradients due to the viscous terms were approximated in the cells by surface integrals along the cell boundaries. A stability analysis for the condition of the local time step for the Runge-Kutta scheme was performed. Results for external and internal flow in two dimensions are presented. The code was verified for the external flow over a NACA 0012 airfoil at different Reynolds numbers and angles of attack, and the results were compared to corresponding compressible cases and to experiments. The code was also applied for the internal flow over a backward facing step for different Reynolds numbers, for which experimental data and numerical results are available. The results agree with other numerical results and with experimental data. ESA

N88-16967# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (West Germany). Inst. fuer Experimentelle Stroemungsmechanik.
INVESTIGATION OF LARGE-SCALE STRUCTURES IN THE NEAR WAKE OF A PARALLEL FLAT PLATE Ph.D. Thesis - Goettingen Univ., Federal Republic of Germany
Volker Strunck Jul. 1987 102 p In GERMAN; ENGLISH summary Report will also be announced as translation (ESA-TT-1100)
(DFVLR-FB-87-31; ISSN-0171-1342; ETN-88-91691) Avail: NTIS HC A06/MF A01; DFVLR, Cologne, Federal Republic of Germany DM 29

The near wake behind a flat plate was investigated using the conditional sampling method and laser Doppler velocimetry. The conditional sampling technique provided information about the development of the separation of the vorticity layers and the

development of turbulence. The created vortices form the configuration of a Karman vortex street at Reynolds numbers 1 million, 1.5 million, and 3 million. It is found that nearly half of the separated vorticity leaving the trailing edge is convected downstream for the production of vortices, and that the vortex energy increases proportional to the turbulent energy. ESA

N88-16968# European Space Agency, Paris (France).
COHERENT VORTEX STRUCTURES IN THE WAKE OF A STATIONARY DISK AND OF A DISK EXCITED TO VIBRATION Ph.D. Thesis - Technische Univ., Berlin, Federal Republic of Germany
Dietmar Scholz Sep. 1987 199 p Transl. into ENGLISH of Kohaerente Wirbelstrukturen im Nachlauf einer Ruhenden und einer Schwingungserregten Kreisscheibe (Federal Republic of Germany) Original language document was previously announced as N86-31851
(ESA-TT-994; DFVLR-FB-86-04; ETN-88-91710) Avail: NTIS HC A09/MF A01; original German version available from DFVLR, Cologne, Federal Republic of Germany DM 46

Coherent votex structures were studied by comparing the large scale coherent flow structure in the wake of a rigid vertical circular disk with the turbulent structures behind the externally driven disk. The periodic vortex structures in these wakes can be decomposed via cross-correlation measurements with hot wires and microphones, particularly by using representations of coherences, phase relations, and azimuthal modes. In the very near wake, coherent periodic pressure oscillations due to pulsing of the recirculation bubble are superimposed onto pressure fluctations of the naturally occurring helical vortex structures which dominate in the entire flow region outside the recirculation bubble. ESA

N88-16969 GKSS-Forschungszentrum Geesthacht (West Germany). Inst. fuer Anlagentechnik.
TWO-PHASE FLOW FORMS AND PRESSURE DROP IN HORIZONTAL T TUBE JOINTS WITH VERTICAL BRANCH Final Report [ZWEIPHASIGE STROEMUNGSFORMEN UND DRUCKABFALL IN HORIZONTALEN T-ROHRVERBINDUNGEN MIT VERTIKALEM ABZWEIG]
A. Katsaounis 19 Jan. 1987 104 p In GERMAN; ENGLISH summary
(GKSS-87/E/12; ISSN-0344-9629; ETN-88-91048) Copyright Avail: Fachinformationszentrum, Karlsruhe, Fed. Republic of Germany

The one and two-dimensional pressure drop at the flow division in the tube branch of the volume-reactor was investigated. Visual observations of the dividing flow and pressure drop measurements were performed in T-junctions with horizontal run and vertical branch. Both tees were geometrically similar, and on a 1:4 scale. The plug/slug and stratified flow patterns in the horizontal tube were determined. Based on the single-phase form-resistance pressure drop correlation of Gardel, a calculation model was developed for the two-phase flow and verified by the measured data. ESA

N88-16970# Fraunhofer-Inst. fuer Solare Energiesysteme, Freiburg (West Germany).
CHARACTERIZATION OF TRANSPARENT INSULATION MATERIALS [CHARAKTERISIERUNG TRANSPARENTER WAERMEDAEMMSTOFFE]
A. Pflueger, W. Platzer, and V. Wittwer 1987 31 p In GERMAN
(ETN-88-91052) Avail: NTIS HC A03/MF A01

Determination of the optical properties of thermal insulators by transmission, reflection, and adsorption measurements, and by the measurement of effective transmission values and thickness dependence of the transmission is described. Determination of the thermal properties of insulators by measurement of heat transmission coefficients, spectral measurements, measurements on filling gases, as well as by a theoretical treatment of the equivalent thermal conductivity is outlined. Suggestions for future investigations are given. Tables with insulation materials data are presented. ESA

N88-16971# Royal Netherlands Meteorological Inst., De Bilt. Afdeling Oceanografisch Onderzoek.
GUIDE FOR THE PROGRAM EXACT-NL
G. Ph. vanVledder and S. L. Weber Feb. 1987 29 p
(KNMI-TR-94; B8715082; ISSN-0169-1708; ETN-88-91337)
Copyright Avail: NTIS HC A03/MF A01

A set of programs called EXACT-NL, which computes fetch or duration limited wave growth with an explicit expression for the resonant four-wave interactions is described. The manual is based on experience with EXACT-NL for the computation of shallow water growth curves and the investigation of the directional response of waves to variations in the wind field. Modifications necessary for these specific purposes are also described. ESA

N88-16972# GKSS-Forschungszentrum Geesthacht (West Germany). Inst. fuer Anlagentechnik.
INVESTIGATION OF CRITICAL HEATING IN NARROW FLOW CHANNELS WITH R12 REFRIGERANT AS MODEL FLUID Thesis - Technische Univ., Brunswick, Federal Republic of Germany [UNTERSUCHUNGEN ZUM KRITISCHEN SIEDEZUSTAND IN ENGEN STROEMUNGSKANAELEN MIT DEM KAELTEMITTEL R12 ALS MODELLFLUID]
T. Mueller-Menzel 18 May 1987 135 p In GERMAN; ENGLISH summary
(GKSS-87/E/25; ISSN-0344-9629; ETN-88-91456) Copyright Avail: NTIS HC A07/MF A01

Results of critical heat flux (CHF) measurements for vertical upflow of Refrigerant 12 at high mass fluxes and high pressures in small diameter tubes are reported. The data are transformed into water data using a scaling law, which is verified by analysis. An error estimation includes the error of the scaling law. Special phenomena (limiting quality, upstream boiling crisis) are explained by theoretical models. The applicability of existing correlation is checked and a CHF-table for small diameter tubes is presented. ESA

N88-16973# Technische Hogeschool, Delft (Netherlands). Dept. of Aerospace Engineering.
CALCULATION OF THE FLOW THROUGH A SINGLE-SIDED SUDDEN EXPANSION WITH THE COMPUTER PROGRAM FOR PARABOLIC AND ELLIPTIC FLOWS (COPPEF) COMPUTER PROGRAM
R. G. Veraar Jun. 1987 57 p Prepared in cooperation with Prins Maurits Lab. TNO
(Contract DLR-15.0120)
(VTH-LR-523; MPL-1987-C-83; SFCC-Pub-45; ETN-88-91565)
Avail: NTIS HC A04/MF A01

The implementation of the single-sided sudden expansion configuration in the Computer Program for Parabolic and Elliptic Flows (COPPEF) is described. Modifications of the computer program were tested and calculations describing the cold flow through a single-sided sudden expansion were carried out. The calculations show that the flow structure and the reattachment length in particular are very sensitive to the inlet flow conditions. Reattachment length is found to vary linearly with the expansion ratio. At high Reynolds numbers, the calculated reattachment length is hardly affected by changing the Reynolds number. Varying the length of the solution domain has no significant effect on the calculated reattachment length. Comparison of the results with experimental data show that COPPEF can calculate the flow through a single-sided sudden expansion in reasonable agreement with experiment. The calculated reattachment length is in close agreement to the reattachment lengths obtained with computer proframs which use the same turbulence closure model as COPPEF. ESA

N88-16974# Institut Franco-Allemand de Recherches, St. Louis (France).
A REVIEW OF SOME FLOW VISUALIZATION EXPERIMENTS CARRIED OUT AT THE INSTITUT FRANCO-ALLEMAND DE RECHERCHES (ISL) SHOCK TUBES
J. Srulijes and F. Seiler 27 Nov. 1986 9 p Presented at the 4th International Symposium on Flow Visualization, Paris, France,

26-29 Aug. 1986
(ISL-CO-243/86; ETN-88-91635) Avail: NTIS HC A02/MF A01

Differential interferometry, tracer particle density visualization by light scattering technique, and Doppler-pictures of the velocity distribution of the tracer particles are reviewed. If certain assumptions concerning the tracers are fulfilled, then the tracer particle density distribution and the tracer velocity distribution can be related to gas density and flow velocity, respectively. Gas jets coming out of a nozzle situated at the end of the shock tube; vortex production behind a sharp edge; vortex and pressure wave formation at trailing edges; and internal flows behind pistons are described. ESA

N88-16975# Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H., Vienna. Inst. fuer Reaktorsicherheit.
THE DYNAMICS OF HEAT TRANSFER AT A TURBULENT PIPE FLOW
Heinz Schmidl Jun. 1987 97 p In GERMAN; ENGLISH summary
(OEFZS-4400; RS-291/87; ETN-88-91656) Copyright Avail: NTIS HC A05/MF A01

The temperature distribution of a turbulent pipe flow is described as a system of differential equations. By changing several parameters these equation are solved. ESA

N88-16976# Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H., Vienna. Inst. fuer Reaktorsicherheit.
PARTICLE TRANSPORT IN MICRODETONATIONS
Gerald Kamelander, Gert Sdouz, Franz Woloch, and Heinz Koinig Jun. 1987 100 p In GERMAN; ENGLISH summary Sponsored by the Austrian Fonds zur Foerderung der Wissenschaftlichen Forschung
(OEFZS-4402; RS-292/87; ETN-88-91657) Copyright Avail: NTIS HC A05/MF A01

The effects of inclusion of reaction particle transport into the physical model of a simulation code was investigated. It is shown that the transport effect may become important. ESA

N88-16977# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Fluid Dynamics Panel.
TECHNIQUES OF FLOW VISUALIZATION
W. Merzkirch and K. Gersten (Ruhr Univ., Bochum, West Germany) Dec. 1987 100 p
(AGARD-AG-302; ISBN-92-835-0438-0) Copyright Avail: NTIS HC A05/MF A01

The methods of flow visualization are reviewed with particular emphasis on their application in wind tunnels, water tunnels, and experiments related to propulsion research. The discussion of methods starts with those that visualize the flow pattern on a solid surface. Then methods visualizing the whole field, either by introducing a foreign substance (smoke, dye) or by making use of refractive index changes in the flowing fluid (optical methods) are examined. Emphasis is placed on the discussion of the physical background of a method rather than on technical details. B.G.

N88-16978# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
DYNAMIC MODELLING BY FINITE ELEMENT METHOD OF AN ELASTO-ACOUSTIC BEAM WITH DUE CONSIDERATION OF FLOW AND VISCOSITY Final Technical Report
N. Piet Aug. 1986 65 p In FRENCH Sponsored by Direction des Recherches, Etudes et Techniques, Paris, France
(PB87-178166; ONERA-RT-3/3596-RY) Avail: NTIS HC E04/MF E04 CSCL 20D

The work was done to develop a model by finite element method, permitting the study of low-frequency harmonic behavior of a slender fluid structure, composed of an elastic pipeline filled with a compressible viscous liquid in flow. The study comes with the general framework of precision studies of the POGO program. The model study has led to the development of a logical Electro-Acoustic Line (EAL), permitting representation of systems in the form of a superelement with defined pulsation-related behavior. A transfer matrix type approach is taken to the fluid part of the system. Structural deformation is appraised by the intermediary of modal deformations of either the empty pipe or pipe filled with congealed fluid. GRA

N88-16979# Sandia National Labs., Albuquerque, N. Mex.
BLAST WAVES GENERATED BY PLANAR DETONATIONS
P. A. Thibault, J. D. Penrose, J. E. Shepherd, W. B. Benedick, and D. V. Ritzel 1987 7 p Presented at the 16th Shock Tube Symposium, Aachen, Fed. Republic of Germany, 26 Jul. 1987 Prepared in cooperation with Combustion Dynamics Ltd., Medicine Hat, Alberta, Rensselaer Polytechnic Inst., Troy, N.Y. and Defence Research Establishment Suffield, Ralston, Alberta
(Contract DE-AC04-76DP-00789)
(DE88-002219; SAND-87-2497C; CONF-870737-4) Avail: NTIS HC A02/MF A01

This paper presents experimental and theoretical studies of blast waves generated by gaseous and HE detonations in long cylindrical tubes. The experimental studies were performed using the 1.8 m diameter shock tube facilities at the Defence Research Establishment Suffield and at the New Mexico Engineering Research Institute. Two gaseous explosives, acetylene-oxygen and hydrogen-air, and one solid explosive, 120g nitroguanidine, were used in order to verify the validity of energy scaling in the far-field. The above experimental work is supported by one- and two-dimensional numerical computations which are based on the Flux Corrected Transport (FCT) algorithm. The experimental results are also analyzed in terms of a simple analytical blast model. DOE

N88-16980# Stanford Linear Accelerator Center, Calif.
A QUALITATIVE STUDY OF WAKE FIELDS FOR VERY SHORT BUNCHES
R. B. Palmer Oct. 1987 8 p Presented at the Workshop on Impedance Beyond Cutoff, Berkeley, Calif., 18 Aug. 1987
(Contracts DE-AC02-76CH-00016; DE-AC03-76SF-00515)
(DE88-002565; SLAC-PUB-4433; CONF-8708177-1) Avail: NTIS HC A02/MF A01

A qualitative treatment is given of both single and multiple cavity wakefields, with the intent of providing some physical insight into the energy and bunch length dependencies. DOE

N88-16981# Lawrence Livermore National Lab., Calif.
TOPP: A POST-PROCESSOR FOR TOPAZ, THE ONE DIMENSIONAL PIPE FLOW ANALYSIS CODE
R. W. Martin Jul. 1987 8 p
(Contract W-7405-eng-48)
(DE88-003711; UCID-21251) Avail: NTIS HC A02/MF A01

TOPP is a Lawrence Livermore National Laboratory (LLNL) post-processor for producing graphical results from the one dimensional pipe flow analysis code, TOPAZ. TOPAZ was written by W. S. Winters of Sandia National Laboratory, Livermore (SNLL) and is available on the CRAY computers at LLNL. The SNLL version of TOPAZ produces a very limited set of variables that can be used as input to a post-processor. The version at LLNL was modified to output every time-dependent variable to an absolute binary file at the user specified minor edit frequency. TOPP reads this absolute binary file and produces a variety of graphical results. DOE

N88-16982# Rensselaer Polytechnic Inst., Troy, N.Y.
AN ANALYSIS OF THE CLOSURE CONDITIONS FOR TWO-FLUID MODELS OF TWO-PHASE FLOW Progress Report No. 2, 1 Apr. 1987 - 31 Mar. 1988
R. T. Lahey, Jr. and D. A. Drew Dec. 1987 68 p
(Contract DE-FG02-86ER-13489)
(DE88-003355; DOE/ER-13489/2) Avail: NTIS HC A04/MF A01

During the second year of this three year research program considerable progress was made in our understanding of how to properly formulate two-fluid models of two-phase flow. The purpose of this report is to highlight the most significant findings made to date. Particular topics covered are: Sonic velocity and critical flow rate, void waves, and the second law of thermodynamics. DOE

N88-16983# Lawrence Livermore National Lab., Calif.
A GUIDE TO THE TRANSIENT THREE PHASE POROUS FLOW MODEL IMPLEMENTED IN THE TWO-DIMENSIONAL CRAY-TENSOR CODE: PHYSICS, NUMERICS, AND CODE DESCRIPTION
E. J. Kansa Nov. 1987 55 p
(Contract W-7405-eng-48)
(DE88-003709; UCID-21260) Avail: NTIS HC A04/MF A01

This report deals with shocks in porous solid material. It will be understood that a shock in porous solid material refers to a propagating discontinuity with a pressure jump over a very small rise time. This report is divided into three sections: a review of the physics and the assumptions contained therein, a review of the relevant numerics necessary to obtain stable numerical solutions for the three phase governing equations, and an outline of the code structure which has been implemented in the CRAY-TENSOR code. DOE

N88-16984# Oak Ridge National Lab., Tenn.
A PROJECT TO EXPERIMENTALLY AND THEORETICALLY EXAMINE FLUID INTERFACIAL WAVE PHENOMENA IN A ROTATING CYLINDRICAL GEOMETRY: CURRENT RESULTS AND FUTURE PLANS
W. F. Lawkins, S. Thompson, W. K. Sartory, G. T. Gillies, and R. C. Ritter Sep. 1987 116 p
(Contract DE-AC05-84OR-21400)
(DE88-003738; ORNL-6419) Avail: NTIS HC A06/MF A01

A prototype of the new instrument for experimentally studying stratified fluid wave phenomena in a rotating cylindrical geometry, both of infinitesimal and nonlinear forms, has been designed, built, and partially characterized. Furthermore, a model for analyzing the use of control forces to eliminate infinitesimal instabilities from the fluid/mechanical system has been developed and used. Finally, a nonlinear model for analyzing forced interfacial waves has been defined and steps are currently being taken to implement that model. DOE

N88-16985 Minnesota Univ., Minneapolis.
A QUASI-THREE-DIMENSIONAL CALCULATION PROCEDURE FOR THE PREDICTION OF FLOW AND HEAT TRANSFER IN HEAT EXCHANGER PASSAGES Ph.D. Thesis
Dipankar Choudhury [1987] 270 p
Avail: Univ. Microfilms Order No. DA8718608

Accurate predictions of the flow field and heat transfer coefficients in heat exchangers is of prime importance because of the widespread use of these devices in the process, power, and automative industries. A computational scheme was developed for predicting 3D flow and temperature fields in heat exchanger passages. This approach uses a quasi-three-dimensional gap-integrated form of the governing equations. These equations can be applied to many situations in which two dimensions of the computational domain are relatively large compared to the third and, thus, the flow pattern is two-dimensional in nature. The governing equations are discretized using a control volume finite difference method and the coupling between the nonlinear equations is handled by the SIMPLER algorithm. The method was tested on a variety of heat exchanger geometries including ones in which periodic boundary conditions are encountered in the streamwise direction. Comparisons were made with fully 3D computations in order to establish a range of geometrical and flow parameters for which the proposed method is accurate. Good accuracy was observed and at the same time considerable savings in computational cost were obtained in comparison with fully 3D methods. Dissert. Abstr.

N88-16986 Michigan State Univ., East Lansing.
EXPERIMENTAL STUDY OF LOCAL NATURAL CONVECTION HEAT TRANSFER IN INCLINED AND ROTATING ENCLOSURES Ph.D. Thesis
J. Fakhri [1987] 227 p
Avail: Univ. Microfilms Order No. DA8722840

The local and mean natural convection heat transfer characteristics were studied experimentally in an air-filled differentially heated enclosure with cross-sectional aspect ratio one. The inclination effect on the flow and heat transfer behaviors was studied. The measurements of local and mean Nusselt numbers were obtained at various inclination angles, ranging from 0 to 180 degrees, for Rayleigh numbers between 10,000 to 1 million. The measured heat flux at the hot and cold boundaries showed a strong dependence on the angle of inclination and Rayleigh number. The study was extended to include the effect of combined heating and rotation on the thermal and hydrodynamic boundary layers. The experimental results showed how the centrifugal and Coriolis forces arising from rotation have remarkably influenced the local heat transfer behavior when compared with the nonrotating results. Local heat fluxes were obtained as a function of Taylor and Rayleigh numbers at different angular positions of the enclosure. Correlations are established for the nonrotating and rotating conditions as a function of Rayleigh and Taylor numbers. Photographs of the flow pattern and isotherms at different inclination angles and rotational speeds are shown, in order to give a greater understanding of the flow and heat transfer behaviors. Dissert. Abstr.

N88-16987# Michigan State Univ., East Lansing.
SYMBOLIC, ALGEBRAIC, AND NUMERIC SOLUTIONS TO HEAT CONDUCTION PROBLEMS USING GREEN'S FUNCTIONS Ph.D. Thesis
Paul Henry Zang [1987] 232 p
Avail: Univ. Microfilms Order No. DA8722899

A new technique, using computer algebra for the symbolic solution of heat diffusion type problems is examined. The new technique involves the Green's function approach and uses Laplace transforms and separation of variables for determining appropriate Green's functions. Data bases of Green's functions and integrals are used to speed up the calculation time of solutions. A systematic and orderly procedure for developing Green's functions which is computationally efficient for small dimensionless times is examined. The small time Green's functions are used in a partitioning scheme which accelerates the evaluation time of the symbolic solutions. Two computer programs are presented that symbolically calculate temperature distributions for a limited number of heat transfer problems. Dissert. Abstr.

N88-16988*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
NUMERICAL MODELING OF MULTIDIMENSIONAL FLOW IN SEALS AND BEARINGS USED IN ROTATING MACHINERY
R. C. Hendricks, L. T. Tam, A. Przekwas, A. Muszynska, M. J. Braun, and R. L. Mullen (Case Western Reserve Univ., Cleveland, Ohio.) [1988] 30 p Prepared for presentation at the 2nd International Symposium on Transport Phenomena, Dynamics, and Design of Rotating Machinery, Honolulu, Hawaii, 4-6 Apr. 1988; sponsored in part by ASME and JSME
(NASA-TM-100779; E-3909; NAS 1.15:100779) Avail: NTIS HC A03/MF A01 CSCL 20D

The rotordynamic behavior of turbomachinery is critically dependent on fluid dynamic rotor forces developed by various types of seals and bearings. The occurrence of self-excited vibrations often depends on the rotor speed and load. Misalignment and rotor wobbling motion associated with differential clearance were often attributed to stability problems. In general, the rotative character of the flowfield is a complex three dimensional system with secondary flow patterns that significantly alter the average fluid circumferential velocity. A multidimensional, nonorthogonal, body-fitted-grid fluid flow model is presented that describes the fluid dynamic forces and the secondary flow pattern development in seals and bearings. Several numerical experiments were carried out to demonstrate the characteristics of this complex flowfield. Analyses were performed by solving a conservation form of the three dimensional Navier-Stokes equations transformed to those for a rotating observer and using the general-purpose computer code PHOENICS with the assumptions that the rotor orbit is circular and that static eccentricity is zero. These assumptions have enabled a precise steady-state analysis to be used. Fluid injection from ports near the seal or bearing center increased fluid-film

direct dynamic stiffness and, in some cases, significantly increased quadrature dynamic stiffness. Injection angle and velocity could be used for active rotordynamic control; for example, injection, when compared with no injection, increased direct dynamic stiffness, which is an important factor for hydrostatic bearings.
Author

N88-16989*# Texas A&M Univ., College Station. Dept. of Aerospace Engineering.
COMPUTATIONAL FLUID DYNAMICS AND AEROTHERMODYNAMICS Semiannual Progress Report, Jul. - Dec. 1987
Leland A. Carlson Mar. 1988 54 p
(Grant NAG9-192)
(NASA-CR-182490; NAS 1.26:182490; TAMRF-Rept-5671-88-01)
Avail: NTIS HC A04/MF A01 CSCL 20D

Approximations applicable to the radiating, reacting, and conducting stagnation region of a hypervelocity vehicle were incorporated into a method for rapidly obtaining approximate solutions. This solution utilizes a coordinate system based upon the origin of the radiative losses and includes in a phenomenologically correct manner the effects of chemical and thermal nonequilibrium, and nonequilibrium, nongray radiative transfer. Results were presented which demonstrate the usefulness of the method and indicate which radiation parameters require further study and definition. Excellent comparisons were obtained with published results for the Fire2 data. An axisymmetric nonequilibrium inverse method was modified and extended and used to investigate and compare various vibration dissociation chemistry coupling models and radiative heat transfer approximations. The similarities, differences, and consequences of using these models in the Aero-assist Orbital Transfer Vehicles flight regime will be discussed. B.G.

N88-16990*# Old Dominion Univ., Norfolk, Va. Dept. of Mechanical Engineering and Mechanics.
NUMERICAL SOLUTIONS OF THREE-DIMENSIONAL NAVIER-STOKES EQUATIONS FOR CLOSED-BLUFF BODIES Progress Report, period ending 31 Oct. 1986
Jamshid S. Abolhassani and Surendra N. Tiwari Nov. 1986 31 p
(Contract NCC1-68)
(NASA-CR-182359; NAS 1.26:182359) Avail: NTIS HC A03/MF A01 CSCL 20D

Methods of grid adaption are reviewed and a method is developed with the capability of adaption to several flow variables. This method is based on a variational approach and is an algebraic method which does not require the solution of partial differential equations. The method has also been formulated in such a way that there is no need for any matrix inversion. The method is used in conjunction with the calculation of hypersonic flow over a blunt nose. The equations of motion are the compressible Navier-Stokes equations where all viscous terms are retained. They are solved by the MacCormack time-splitting method and a movie has been produced which shows simultaneously the transient behavior of the solution and the grid adaption. The results are compared with the experimental and other numerical results.
Author

N88-16736# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Structures and Thermal Control Div.
HEAT PIPES FOR SPACE USE
A. Accensi and C. J. Savage *In its* ESA Bulletin No. 10 Aug. 1977 p 49-55 (For primary document see N88-16728 09-12)
Avail: NTIS HC A05/MF A01

N88-17434# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Cologne (West Germany). Inst. fuer Theoretische Stroemungsmechanik.
NUMERICAL FLUID MECHANICS [NUMERISCHE STROEMUNGSMECHANIK]
Herbert Oertel *In its* Scientific Colloquium in Honor of Prof. Dr. Rer. Nat. Hermann L. Jordan Jun. 1987 p 37-55 In GERMAN (For primary document see N88-17432 09-70)
Avail: NTIS HC A07/MF A01; DFVLR, Cologne, Fed. Republic of Germany DM 29

35 INSTRUMENTATION AND PHOTOGRAPHY

Includes remote sensors; measuring instruments and gages; detectors; cameras and photographic supplies; and holography.

For aerial photography see *43 Earth Resources and Remote Sensing.* For related information see also *06 Aircraft Instrumentation,* and *19 Spacecraft Instrumentation.*

N88-16991# Electronics Research Lab., Adelaide (Australia).
CHARACTERISTICS OF AN EBERT MONOCHROMATOR FOR AN INFRARED SPECTROMETER IN THE WAVELENGTH RANGE 1 MICROMETER TO 15 MICROMETERS
S. S. Ti Apr. 1987 21 p
(AD-A186945; ERL-0409-TM; DODA-AR-004-936) Avail: NTIS HC A03/MF A01 CSCL 20F

An Ebert monochromator of a UV spectroradiometer is to be adapted for use in an IR spectrometer in the wavelength-range 1 to 15 microns. The adaption requires a set of respecified data based on theoretical considerations of the geometrical feature of the monochromator. The basic principles are outlined and the new specification is summarized. GRA

N88-16992# Lockheed Missiles and Space Co., Palo Alto, Calif. Research and Development Div.
HIGH-RESOLUTION REAL-TIME RADIOGRAPHY (RTR) SYSTEM DESIGN Final Report, Jul. 1983 - Nov. 1986
L. M. Klynn, R. C. Barry, M. D. Barker, C. Bueno, and T. G. Maple Jul. 1987 139 p
(Contract F33615-82-C-5087)
(AD-A187107; LMSC-D067282; AFWAL-TR-87-4055) Avail: NTIS HC A07/MF A01 CSCL 14B

A high-resolution real-time radiography (RTR) system was designed for aerospace component X-ray inspections in the 20 to 300 kV range. Particulate and glass X-ray converters, image intensifiers, and video camera components were performance tested for resolution greater than 10 lp/mm, dynamic range greater than 1000, contrast sensitivity of 1 percent, and image size of 12 x12 in. A breadboard RTR system, constructed with optimized components, produced 1024 x 1024 pixels per image with 8 bits per pixel. Computer controlled optical zooming achieved horizontal fields of view from 12.8 to 0.5 in. and corresponding resolutions of 3 to 80 pixels mm. Conceptual high-resolution RTR prototype systems were designed using the test results. GRA

N88-16993# Sandia National Labs., Albuquerque, N. Mex. Structural Mechanics Div.
EARTH PENETRATOR STRAIN GAGE APPLICATIONS
Rodney A. May and Larry R. Dorrell 1987 9 p Presented at the IMOG Fall Meeting, Kansas City, Mo., 3 Nov. 1987
(Contract DE-AC04-76DP-00789)
(DE88-002260; SAND-87-2561C; CONF-871184-1) Avail: NTIS HC A02/MF A01

During earth entry of high speed projectiles large, time-dependent forces are applied to the structure. In order to accurately model the response of these penetrators using both finite element methods and lumped mass-spring models, this force-time relationship must be quantified and used as an input for the analytical models. Two earth penetrators were internally strain gaged to obtain strains in the penetrator body which could be used to calculate the applied forces. The installation techniques used to install the gages 0.46 m (18 in.) from the end of the 127 mm (5 in.) inside diameter penetrator case are presented. Gage and adhesive selection as well as wiring and data acquisition techniques designed to survive the high inertial loads encountered

during earth entry are discussed and preliminary results from the first test are shown. DOE

N88-16994# Washington Univ., Seattle. Lab. for Chemometrics.
TENSORIAL CALIBRATION. 2. SECOND ORDER TENSORIAL CALIBRATION Interim Report
Eugenio Sanchez and Bruce R. Kowalski 12 Oct. 1987 30 p
(Contract N00014-75-C-0536)
(AD-A186614; TR-37) Avail: NTIS HC A03/MF A01 CSCL 14B

Tensorial calibration provides a useful approach to calibration in general. For calibration of instruments that produce two dimensional (second order) data arrays of data per sample, tensorial concepts are a natural way of solving the calibration problems as vectorial concepts are for multivariate problems. Similarly, for third and higher order data, the tensorial description of calibration is also useful. This paper introduces second order calibration from a tensorial point of view. Univariate, multivariate and bilinear approaches to calibration are presented. The generalized rank annihilation method (GRAM) is described from the tensorial perspective, and it is shown that GRAM is equivalent to finding a second order tensorial base that spans both tensors (calibration and unknown) with respective diagonal component matrices. GRAM uses a single calibration sample of multicomponent analysis even in the presence of interferences. Second order bilinear calibration is extended to multiple calibration samples, where the effect of collinearities is reduced. GRA

N88-16995# Washington Univ., Seattle. Lab. for Chemometrics.
TENSORIAL CALIBRATION. PART 1: FIRST ORDER TENSORIAL CALIBRATION Interim Report
Eugenio Sanchez and Bruce R. Kowalski 12 Oct. 1987 43 p
(Contract N00014-75-C-0536)
(AD-A186708; TR-37) Avail: NTIS HC A03/MF A01 CSCL 14B

Many analytical instruments now produce one-, two- or n-dimensional arrays of data that must be used for the analysis of samples. An integrated approach to linear calibration of such instruments is presented from a tensorial point of view. The data produced by these instruments is seen as the components of a first, second or the order tensor, respectively. In this first paper, concepts of linear multivariate calibration are developed in the framework of first order tensors, and it is shown that the problem of calibration is equivalent to finding the contravariant vector corresponding to the analyte being calibrated. A model of the subspace spanned by the variance in the calibration must be built to compute the contravariant vectors. It is shown that the only difference between methods such as least squares, principal components regression, ridge regression, latent root regression and partial least squares resides in the choice of the model. GRA

N88-16996# Royal Inst. of Tech., Stockholm (Sweden). Dept. of Plasma Physics.
TESTING A VERY GOOD MICROWAVE INTERFEROMETER
Nils Brenning Oct. 1986 21 p
(TRITA-EPP-86-09; ISSN-0348-7539; ETN-88-91676) Avail: NTIS HC A03/MF A01

A 4 mm microwave interferometer, and a working system for numerical evaluation of the recorded signals are described. The interferometer signals are processed in a computer to provide immediate display of the plasma column density. The numerical evaluation makes it possible to eliminate the influence of imperfections in the components, and to take into account large and rapid variations in the strength of the transmitted microwave signal. The limits of performance of the system are tested in a pulsed plasma source. Column plasma densities are measured from 10 to the 15th power/sqm to 3 to the 18th power/sqm, corresponding to phase swings from less than 1 degree to several times 360 degrees. The upper limit corresponds to densities approaching the cutoff density, 6 times 10 to the 19th power/cum, where reflection and refraction of the transmitted beam become severe. Measurements are possible even when the power in the transmitted branch is reduced (due to the plasma) by more than a factor 30, and when the transmitted power varied as rapidly as a factor 4 in 200 nsec. ESA

N88-16997# Gesamthochschule, Wuppertal (West Germany). Dept. of Physics.
AN INFRARED GRATING SPECTROMETER FOR GIRL Final Report
Peter Knieling, Guenther Lange, Dirk Offermann, and Klaus-Ulrich Grossmann Bonn, West Germany Bundesministerium fuer Forschung und Technologie Aug. 1986 79 p In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie, Fed. Republic of Germany
(ETN-88-91071) Avail: NTIS HC A05/MF A01

A grating spectrometer with medium spectral resolution was developed for the GIRL project (Experiment E3), for the determination of the emission of trace constituents in the Earth's atmosphere, and for planetary and astronomical measurements. The spectrometer consists of two Ebert-Fastie spectrometers covering the wavelength range between 2.5 and 100 micron. The engineering model of E3 is described, and the design data are given. The engineering model was verified during operation in a cryostat at liquid helium temperatures. The spectral channels and respective IR filters were designed. Stray light suppression during limb scan measurements is explained. Absorption and emission spectra of atmospheric trace gases were measured. ESA

N88-16998# Institut fuer Angewandte Geodaesie, Frankfurt am Main (West Germany).
THE SUPERCONDUCTING GRAVIMETER: APPLICATION, CALIBRATION, AND FURTHER DEVELOPMENT Ph.D. Thesis - Bonn Univ., West Germany [DAS SUPRALEITENDE GRAVIMETER: ANWENDUNG, EICHUNG UND UEBERLEGUNGEN ZUR WEITERENTWICKLUNG]
Bernd Richter 1987 125 p In GERMAN
(Ser-C-329; ISSN-0071-9196; ETN-88-91091) Avail: NTIS HC A06/MF A01

The superconducting gravimeter and the evaluation of its measuring data are presented. The theory of the static gravimeter is given. The principle of superconductivity, the technical realization of a superconducting gravimeter, and the acquisition of the measuring signals are treated. The methods applied for the calibration of gravimeters are presented. The evaluation of the measurements with the superconducting gravimeter, including drift, gravimeter registrations, and parallel observations with two superconducting gravimeters, is explained. The further development of the gravimeter to a driftfree gravimeter and an instrument providing absolute values is discussed. ESA

N88-16999 National Physical Lab., Teddington (England). Div. of Radiation Science and Acoustics.
RECOMMENDATIONS FOR ORGANISING THE CALIBRATION OF PURE-TONE AUDIOMETERS
M. S. Shipton, comp. Jul. 1987 29 p
(NPL-AC-112; ISSN-0143-7143; ETN-88-91519) Copyright Avail: Issuing Activity

A three-tier strategy for maintaining correct calibration of audiometric test equipment is described. The first two tiers represent routine checking performed on the equipment in situ, and the third tier represents nonroutine, on demand, repair at a central laboratory with a full recalibration and a check to specification. ESA

N88-17000# Royal Signals and Radar Establishment, Malvern (England).
HOLOGRAPHIC PHASE CORRECTION
C. W. Slinger Jun. 1987 23 p
(RSRE-MEMO-4036; BR103152; ETN-88-91538) Copyright Avail: NTIS HC A03/MF A01

Holography is shown to be a powerful technique for phase correction, due to its ability to correct any wavefront into another,

desired, wavefront. The technique is compact, rugged, and reasonably efficient. However, it is limited to use in systems where monochromatic, spatially coherent light is used. Positional tolerance is also important, and choice of recording material (and substrate, if any) must be made depending on the degree of phase correction required. Accurate, low noise correction of complex phase objects requires a material of good optical quality and with a high modulation thickness product (so enabling high beam ratios to be used). ESA

N88-17001# Eidgenoessisches Flugzeugwerk, Emmen (Switzerland). Abteilung Versuchs- und Forschungsanlage.
STRAIN GAGE BALANCE FOR HALF MODELS 302-6. CALIBRATION REPORT
Heinz Blaettler 28 Feb. 1986 106 p In GERMAN; ENGLISH summary
(F+W-FO-1803; ETN-88-91685) Avail: NTIS HC A06/MF A01

A six-component strain gage balance for half models 302-6 for the transonic wind tunnel was developed and calibrated. The calibration was executed with a special lever, so that forces and moments could be loaded at the point of attack of the model. Point 8 (for recording buffering) was also measured. The balance is conceived for: X = +/- 100 (N); Mx = +/- 200 (Nm); Y = +/- 200 (N); My = +/- 35 (Nm); Z = +/- 1000 (N); and Mz = +/- 30 (Nm). ESA

N88-17002# Eidgenoessisches Flugzeugwerk, Emmen (Switzerland). Abteilung Versuchs- und Forschungsanlage.
STRAIN GAGE STING BALANCE 204-6. CALIBRATION REPORT
Heinz Blaettler 10 Dec. 1986 138 p In GERMAN; ENGLISH summary
(F+W-FO-1838; ETN-88-91686) Avail: NTIS HC A07/MF A01

The strain gage sting balance 204-6 was developed for aerodynamic measurements on rocket models in the transonic and supersonic wind tunnel. Data are: X = +/- 50 (N); Y = +/- 150 (N); Z = +/- 400 (N); Mx = +/- 1.5 (Nm); My = +/- 20 (Nm); and Mz = +/- 10 (Nm). Compared to the existing balances of same size the ratio Y/Z is changed from 1:8 to 1:3.75. This change of specifications was introduced with regard to measurements to be taken with a sting providing automatic roll positioning around the X-axis. The resistance module was separately constructed and prestressed by a factor of 0.5, and connected to the model and sting part of the balance by electron-beam welding. ESA

N88-17003# Centro Informazioni Studi Esperienze, Milan (Italy).
REALIZATION OF AN INSTRUMENT TO MEASURE TEMPERATURE AND CONCENTRATION GRADIENTS IN FLUIDS Final Report
M. Giglio, E. Paganini, and U. Perini Paris, France ESA 11 Feb. 1987 70 p
(Contract ESA-6016/84-NL-PR(SC))
(CISE-3128; ESA-CR(P)-2512; ETN-88-91707) Avail: NTIS HC A04/MF A01

The point diffraction interferometer (PDI) was chosen as candidate for an interferometer to be used for fluid studies in low gravity. The PDI has a minimal number of elements, it is a self referencing interferometer, and therefore it is intrinsically very stable, and can be easily transformed into a high quality Schlieren system. It is suitable for a self aligning scheme. The optical layout, optical and mechanical compoments, the sensor, the servoloop electronic scheme, the recording system, and the test cell are described. A user manual and interferograms of fluid mixtures are presented. ESA

N88-17004# Lawrence Livermore National Lab., Calif.
MULTI-COMPONENT STRESS HISTORY MEASUREMENTS AND ANALYSIS
R. B. Stout and D. B. Larson Aug. 1987 45 p Presented at the 4th Symposium on Containment of Underground Nuclear Explosions, Colorado Springs, Colo., 21 Sep. 1987
(Contract W-7405-eng-48)
(DE88-000977; UCRL-96319; CONF-870961-4) Avail: NTIS HC A03/MF A01

Piezoresistance foil gages were tested dynamically in multi-component stress-strain experiments in order to be able to simulate more accurately actual shock wave conditions of underground nuclear testing. The multi-component stress-strain histories were created in polymethyl methacrylate (PMMA) by using chemical explosions to generate spherical shock waves. In addition to the resistivity measurements from the foil gages, particle velocity was measured at several radial positions from the explosion. The gage interpretation (inverse) problem for multi-component stress-strain fields requires obtaining a sufficient number of independent measurements so that the different stress-strain components influencing the gage response can be uniquely inferred. The piezoresistance measurements provided data from a triple material foil gage and from ytterbium foil (bare) gages. An analysis shows that the triple material gage containing foils of ytterbium, manganin, and constantan provided three independent resistivity measurements for the gage oriented in a perpendicular direction relative to the radial propagating shock front. An analysis of the ytterbium foil gages, which were tested in both (normal) and parallel (tangential) directions relative to the radial shock front, show the resistivity responses from these two orientations are independent measurements. Results compared well with experimental data. This analysis shows that the material properties, the dimensions, and the material surrounding the foil greatly influence the total resistivity response of foil gages in a multi-component stress-strain field. DOE

N88-17005# Lawrence Livermore National Lab., Calif.
FLAT-FIELD RESPONSE AND GEOMETRIC DISTORTION MEASUREMENTS OF OPTICAL STREAK CAMERAS
D. S. Montgomery, R. P. Drake, B. A. Jones, and J. D. Wiedwald Aug. 1987 8 p Presented at the 31st SPIE Annual International Technical Symposium on Optical and Optoelectronic Applied Science and Engineering, San Diego, Calif., 16 Aug. 1987
(Contract W-7405-eng-48)
(DE88-002394; UCRL-96565; CONF-8708110-28) Avail: NTIS HC A02/MF A01

To accurately measure pulse amplitude, shape, and relative time histories of optical signals with an optical streak camera, it is necessary to correct each recorded image for spatially-dependent gain nonuniformity and geometric distortion. Gain nonuniformities arise from sensitivity variations in the streak-tube photocathode, phosphor screen, image-intensifier tube, and image recording system. These nonuniformities may be severe, and were observed to be on the order of 100 percent some LLNL optical streak cameras. Geometric distortion due to optical couplings, electron optics, and sweep nonlinearity not only affects pulse position and timing measurements, but pulse amplitude and shape measurements as well. By using a 1.053-micron, long-pulse, high-power laser to generate a spatially and temporally uniform source as input to the streak camera, the combined effects of flat-field response and geometric distortion can be measured under the normal dynamic operation of cameras with S-1 photocathodes. Additionally, by using the same laser system to generate a train of short pulses that can be spatially modulated at the input of the streak camera, we can effectively create a 2-D grid of equally space pulses. This allows a dynamic measurement of the geometric distortion of the streak camera. The techniques involved in performing these calibrations, measured results for LLNL optical streak cameras, and software methods to correct for these effects are discussed. DOE

N88-17006# Argonne National Lab., Ill.
CALCULATED SPUTTERING AND ATOMIC DISPLACEMENT CROSS-SECTIONS FOR APPLICATIONS TO MEDIUM VOLTAGE ANALYTICAL ELECTRON MICROSCOPY
C. R. Bradley and N. J. Zaluzec Aug. 1987 17 p Presented at the Pacific Workshop and Meeting on Analytical Electron Microscopy, Kona, Hawaii, 12 Jul. 1987
(Contract W-31-109-eng-38)

(DE88-002904; CONF-870733-14) Avail: NTIS HC A03/MF A01

The development of medium voltage electron microscopes having high brightness electron sources and ultra-high vacuum environments has been anticipated by the microscopy community now for several years. The advantages of such a configuration have been discussed to great lengths, while the potential disadvantages have for the most part been neglected. The most detrimental of these relative to microcharacterization are the effects of electron sputtering and atomic displacement to the local specimen composition. These effects have in the past been considered mainly in the high voltage electron microscope regime and generally were ignored in lower voltage instruments. Recent experimental measurements have shown that the effects of electron sputtering as well as radiation induced segregation can be observed in conventional transmission electron microscopes. It is, therefore, important to determine at what point the effects will begin to manifest themselves in the new generation of medium voltage analytical electron microscopes. In this manuscript we present new calculations which allow the individual experimentalist to determine the potential threshold levels for a particular elemental system and thus avoid the dangers of introducing artifacts during microanalysis. DOE

N88-17007# Lawrence Livermore National Lab., Calif.
RESOLUTION LIMITATIONS AND OPTIMIZATION OF THE ITT F4157 STREAK TUBE FOCUS FOR FAST (10 ps) OPERATION
R. A. Lerche, E. L. Grasz, R. L. Griffith, R. A. Simpson, and R. Posey Nov. 1987 22 p
(Contract W-7405-eng-48)
(DE88-003727; UCID-21258) Avail: NTIS HC A03/MF A01

The ITT F4157 image tube is biased at voltages far from the original design for operation in an ultrafast (10 ps) streak camera. Its output resolution at streak camera operating potentials was measured as a function of input slit width, incident-light wavelength, and focus-grid voltage. The results are similar to those reported for the RCA C73435 streak tube. Indeed, the two tubes can be substituted for each other with minor mechanical modifications. The temporal resolution is insensitive to focus-grid voltage for a narrow (50 micron) input slit, but is very sensitive to focus-grid voltage for a wide (500 micron) input slit. Spatial resolution is nearly independent of focus-grid voltage for values that give good temporal resolution. Both temporal and spatial resolution depend on the incident-light wavelength. Streak camera operation is simulated with a computer program that calculates photoelectron trajectories. Electron ray tracing describes the observed effects of slit width, incident-light wavelength, and focus-grid voltage on the output resolution. DOE

N88-17008# Lawrence Livermore National Lab., Calif.
THE 5-GHz OPERATION OF THE ITT AND RCA STREAK TUBES WITH A 7.5-ns TIME WINDOW
R. A. Lerche, E. L. Grasz, and R. L. Griffith Nov. 1987 17 p
(Contract W-7405-eng-48)
(DE88-003342; UCID-21264) Avail: NTIS HC A03/MF A01

Two streak cameras, one based on the ITT F4157 streak tube and one based on the RCA C73435 image converter tube have been operated at 5-GHz with twelve input channels and a time window of 7.5 ns. Under the operating conditions used to achieve this performance, the two cameras exhibit similar characteristics. Indeed, the tubes can be substituted for each other with minor mechanical modifications to the camera body. DOE

N88-17009# National Aerospace Lab., Tokyo (Japan).
TURBINE FLOW METER WITH OPTICAL FIBER PICK-UP
Yukio Matsuda and Masanori Endoh 1987 15 p In JAPANESE; ENGLISH summary
(NAL-TR-923; ISSN-0389-4010) Avail: NTIS HC A03/MF A01

For measurement of the flow rate of liquid and gas, a turbine flow meter is widely used for its easy handling characteristics and high reliability. However, there are still problems of narrow covering range and electric noise. These problems are mainly caused by the electromagnetic pick-up. An optical fiber pick-up turbine flow meter (OTF) has been developed to resolve these problems by using an optical fiber pick-up instead of the conventional electromagnetic pick-up to detect the passage of turbine blades. The OTF output signal is a pulse train with a constant amplitude (1V peak) in all ranges covered. An eminent improvement of linearity is realized in the lower flow rate range. Various kinds of aeroengine start and performance tests have proved the OTF to be very useful. Author

N88-17010# National Aerospace Lab., Tokyo (Japan).
STUDY ON A UNIDIRECTIONAL RING LASER GYRO. PART 1: PROPOSITION OF THE PRINCIPLE AND STUDIES ON THE COMPONENTS
Minoru Takizawa May 1987 39 p In JAPANESE; ENGLISH summary
(NAL-TR-933; ISSN-0389-4010) Avail: NTIS HC A03/MF A01

Study of a Unidirectional Ring Laser Gyro (URLG) is being carried out at NAL (National Aerospace Laboratory) in studies on an advanced automatic flight control system (Fly-By-Light System) for STOL aircraft. The purpose of the study is to develop a laser gyroscope which has such properties as high accuracy, high reliability, a very long service life and low cost. The laser gyro has no lock-in region and no moving parts. The principle of the laser gyro is proposed, and the behavior and the potential performance of the laser gyro are discussed theoretically. Furthermore, the results of the experimental studies of the main components, i.e., a ring laser, a V shaped linear laser, an optical diode and an optical read-out device are described. Author

N88-17011# Aeronautical Research Labs., Melbourne (Australia).
PERFORMANCE OF A DIGITAL REAL TIME RADIOGRAPHIC IMAGING SYSTEM
M. J. Chung Jun. 1987 26 p
(MRL-R-1068; AR-005-148) Avail: NTIS HC A03/MF A01

The radiographic and electro-optical characteristics of a digital, real-time radiographic imaging system are examined. It is found that: (1) for optimum X-ray magnifications the television camera tube in the system has a significant effect on image quality, and (2) large variations in X-ray tube voltage may be tolerated before image degradation prevents successful computer image processing. This work forms part of a study on a computer-aided inspection process. Author

N88-17012# Aeronautical Research Labs., Melbourne (Australia).
THE WAFTER: A VERSATILE WEAR AND FRICTION TESTER
P. Jewsbury Jun. 1987 21 p
(MRL-TN-519; AR-005-153) Avail: NTIS HC A03/MF A01

Described are the design and use of a pins-on-disc wear and friction testing machine, constructed for use in the Wear Technology Group. The tester is capable of assessing sliding wear at speeds up to 4 m/sec and loads up to 40 N. During a wear run the friction and contact resistance are constantly monitored giving a clear picture of the condition of the surfaces. Author

N88-17013 Illinois Univ., Urbana-Champaign.
COMPARISON OF DIRECT AND HETERODYNE DETECTION OPTICAL INTERSATELLITE COMMUNICATION LINKS Ph.D. Thesis
Chien-Chung Chen [1987] 224 p
Avail: Univ. Microfilms Order No. DA8721603

The performance of direct and heterodyne detection optical intersatellite communication links are evaluated and compared. It is shown that the performance of optical links is very sensitive to the pointing and tracking errors at the transmitter and receiver. In the presence of random pointing and tracking errors, optimal antenna gains exist that will minimize the required transmitter power. In addition to limiting the antenna gains, random pointing and tracking error also impose a power penalty in the link budgets. The link budgets for direct and heterodyne detection systems are evaluated. It is shown that, for systems with large pointing and tracking errors, the link budget is dominated by the spatial tracking

error, and the direct detection system shows a superior performance because it is less sensitive to the spatial tracking error. On the other hand, for systems with small pointing and tracking jitters, the antenna gains are in general limited by the launch cost, and suboptimal antenna gains are often used in practice. In which case, the heterodyne system has a slightly higher power margin because of the higher receiver sensitivity.
Dissert. Abstr.

N88-17054# Naval Ship Research and Development Center, Bethesda, Md. Underwater Explosions Research Div.
AN INTEGRATION TEST FOR ACCELEROMETER EVALUATION
Eric C. Hansen *In* Shock and Vibration Information Center The Shock and Vibration Bulletin. Part 2: Instrumentation, Shock Analysis and Shock Testing Jan. 1987 p 1-10 (For primary document see N88-17053 09-39)
Avail: NTIS HC A08/MF A01 CSCL 14B

N88-17056# Naval Sea Systems Command, Washington, D.C.
A QUANTITATIVE METHOD FOR EVALUATING SENSOR LAYOUTS
T. F. Chwastyk and D. G. Rapp (Westinghouse Electric Corp., West Mifflin, Pa.) *In* Shock and Vibration Information Center The Shock and Vibration Bulletin. Part 2: Instrumentation, Shock Analysis and Shock Testing Jan. 1987 p 21-54 (For primary document see N88-17053 09-39)
Avail: NTIS HC A08/MF A01 CSCL 14B

N88-17403# Joint Publications Research Service, Arlington, Va.
CALCULATION OF NOISE IN SPATIAL SPECKLE-FIELD HOLOGRAMS UNDER CONDITIONS OF SATURATED PHOTORESPONSE Abstract Only
V. V. Shkunov and T. V. Yakovleva *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 27 Oct. 1987 p 9 Transl. into ENGLISH from Kvantovaya Elektronika (Moscow, USSR), v. 14, no. 3, Mar. 1987 p 460-465 Original language document was announced in IAA as A87-43538 (For primary document see N88-17395 09-70)
Avail: NTIS HC A04/MF A01

N88-17407# Joint Publications Research Service, Arlington, Va.
COLOR SHADOW METHODS OF ANALYZING RECONSTRUCTED WAVE FRONT Abstract Only
I. S. Zeylikovich, A. M. Lyalikov, and N. M. Spornik *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 27 Oct. 1987 p 22 Transl. into ENGLISH from Optika i Spektroskopiya (Leningrad, USSR), v. 62, no. 3, Mar. 1987 p 659-663 (For primary document see N88-17395 09-70)
Avail: NTIS HC A04/MF A01

N88-17409# Joint Publications Research Service, Arlington, Va.
KINETICS AND SPECTRUM OF LIGHT PULSE USED IN PICOSECOND HOLOGRAPHY Abstract Only
R. F. Malikov and R. Kh. Mustafin *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 27 Oct. 1987 p 24 Transl. into ENGLISH from Optika i Spektroskopiya (Leningrad, USSR), v. 62, no. 3, Mar. 1987 p 631-635 (For primary document see N88-17395 09-70)
Avail: NTIS HC A04/MF A01

36 LASERS AND MASERS

Includes parametric amplifiers.
For related information see also *76 Solid-State Physics.*

N88-17014# TRW Energy Systems Group, Redondo Beach, Calif.
PHOTODETACHMENT NEUTRALIZER DEVELOPMENT: LASER WINDOW DESIGN STUDY. VOLUME 2: WINDOW DESIGN DETAILS Final Report
1987 71 p Prepared in cooperation with Lawrence Livermore National Lab., Calif.
(Contract W-7405-eng-48)
(DE88-000783; UCRL-15649-Vol-2) Avail: NTIS HC A04/MF A01

During 1983, TRW conducted a photodetachment neutralizer development (PDN) - Laser Resonator study. The emphasis of this contract was to assess a technology base of the PDN concept. Three technology assessments were conducted: Mirror Technology assessments, Window Engineering Analysis/Technology assessment, and COIL medium modeling with emphasis on PDN issues. Based on the results of these technology assessments the follow-on contract was funded to develop a technology verification. Due to funding limitations this technology verification program was divided into two separate follow-on contracts. Under this follow-on contract, the following tasks were performed: Measure Attenuation Coefficient of 3M FC-104, FC-77, FC-43 with temperature and attenuation coefficient of sapphire, generate finite element/finite difference thermal/structural model of the HEX double window, determine thermal/structural response from the proposed operating conditions, develop option response data from the deflection/stress inputs, recommend design and operating parameters for demonstrator and operational HEX double window, generate Level 1 layouts and drawings of double paned demonstrator window and window mount/manifold, and generate preliminary layout drawings of shutter. Thermal and structural analyses were conducted for both the operational and demonstrator window heat exchanger (HEX) designs and operating conditions.
DOE

N88-17015# Naval Research Lab., Washington, D.C.
THE STRUCTURE OF THE SIDEBAND SPECTRUM IN FREE ELECTRON LASERS Interim Report
S. Riyopoulos and C. M. Tang 19 Nov. 1987 67 p
(AD-A186952; NRL-MR-6118) Avail: NTIS HC A04/MF A01 CSCL 09C

The one-dimensional, fast-time averaged Hamiltonian is derived in a free electron laser (FEL) for electrons passing through a constant parameter wiggler and a radiation field. The exact unperturbed orbits without sidebands are obtained for all particles and arbitrary separatrix height delta sub gamma. Integration, in action-angle variables, of the linearized kinetic equation with perturbing sidebands over the unperturbed orbits yields the sideband growth rate including both trapped and untrapped particles. The structure and scaling of the unstable spectrum are different from previous results obtained for electrons localized at the bottom of the ponderomotive well. Upper and lower sidebands that are symmetric relative to the FEL frequency have opposite growth rates. There is no differentiation in the magnitude of the gain between upper and lower sidebands. The stability is determined by the sign of df sub 0/d omega sub b, the relative population of quantized oscillators with energy quantum h-bar, omega sub b where omega sub b is the synchrotron frequency in resonance with the sideband. The shear d omega sub b/dJ, where J is the action variable, is stabilizing and distributions with gradients of df sub 0/dJ localized near the separatrix have the minimum growth rates.
GRA

N88-17016# Physical Sciences, Inc., Andover, Mass.
SOLAR PUMPED, ALKALI VAPOR LASER Final Report, 1 Sep. 1984 - 31 Aug. 1986
David Ham and Mark A. DeFaccio 4 Sep. 1987 58 p
(Contract F49620-84-C-0118)
(AD-A187156; PSI-118/TR-718; AFOSR-87-1535TR) Avail: NTIS HC A04/MF A01 CSCL 09C

High power lasers based in space have been considered as sources for power transmission, laser propulsion, materials processing and space defense. The feasibility of such systems is based on the cost per unit power delivered, with detailed studies indicating that light weight has a greater impact on cost than laser efficiency. Solar radiation is a natural source of power for these devices and two methods for conversion of solar radiation to laser radiation can be considered. An indirectly solar pumped laser would first convert the solar radiation to electricity or longer wavelength blackbody radiation which is then used to power the

laser. A directly longer wavelength blackbody radiation which is then used to power the laser. A directly pumped solar laser would utilize a portion of te solar spectrum to directly pump the laser medium, eliminating the intervening step and substantially reducing the systems weight and complexity. Detailed comparisons showed a directly pumped laser with an overall efficiency of only 1.5 percent can compete with an indirectly energized solar laser with an overall efficiency of ten percent. With this in mind, a concept for a directly solar pumped laser was developed based on an alkali vapor (sodium) as the laser medium. GRA

N88-17017# Lawrence Livermore National Lab., Calif. Physics Dept.
NUCLEAR EXCITATION VIA THE MOTION OF ELECTRONS IN A STRONG LASER FIELD Final Report
J. F. Berger, D. Gogny, and M. S. Weiss Jun. 1987 48 p Submitted for publication Prepared in cooperation with Commissariat de l'Energie Atomique, Bruyeres-le-Chatel, France
(Contract W-7405-eng-48)
(AD-A187166; UCRL-96759) Avail: NTIS HC A03/MF A01 CSCL 09C

A method of switching from a nuclear isomeric state to a lasing state is examined. A semi-classical model of laser-electron-nuclear coupling is developed. In it the electrons are treated as free in the external field of the laser, but with initial conditions corresponding to their atomic orbits. Application is made to testing this model in U-235 and to the design criteria of a gamma ray laser. GRA

N88-17018# Air Force Weapons Lab., Kirtland AFB, N. Mex.
O2-I LASER (OXYGEN-IODINE) MIXING STUDIES USING LIF (LASER INDUCED FLUORESCENCE) Final Report, Jan. 1983 - Jan. 1985
Y. D. Jones, D. Plummer, L. D. Watkins, and G. D. Hager Jul. 1987 38 p
(AD-A186667; AFWL-TR-86-119) Avail: NTIS HC A03/MF A01 CSCL 20E

Laser Induced Fluorescence (LIF) was incorporated to study the degree of mixing in two subsonic nozzle variations for the O2-I laser system. The studies were performed using a testbed version of COIL-IV, an O2-I laser. I2 was injected through the nozzles and excited with an Ar laser to produce fluorescence. The observed jet trajectories could then be compared to trajectories predicted by computer models. Velocity distributions were measured at several flow rates. The LIF allowed for an evaluation of the relative degree of mixing produced by the two nozzles resulting in a modification of the O2-I laser. GRA

N88-17019# California Univ., Santa Barbara. Dept. of Chemistry.
ENERGY DISPOSAL IN ION-MOLECULE REACTIONS Final Report, 1 Jul. 1986 - 19 May 1987
Michael T. Bowers 25 Sep. 1987 5 p
(Grant AF-AFOSR-0286-86)
(AD-A186772; AFOSR-87-1512TR) Avail: NTIS HC A02/MF A01 CSCL 07D

An Excimer Laser and Dye Laser were purchased. Preliminary experiments were completed in 3 areas: ion beam studies of state selected ions; semiconductor clusters; and radiative lifetimes of long lived ionic states. GRA

N88-17020*# RCA Labs., Princeton, N. J.
AlGaAs HETEROJUNCTION LASERS Final Report, 28 Jun. 1985 - 27 Jun. 1986
B. Goldstein, G. N. Pultz, D. B. Carlin, S. E. Slavin, and M. Ettenberg Feb. 1988 157 p
(Contract NAS1-17441)
(NASA-CR-4119; NAS 1.26:4119; RCA-PRRL-87-CR-1) Avail: NTIS HC A08/MF A01 CSCL 20E

The characterization of 8300 A lasers was broadened, especially in the area of beam quality. Modulation rates up to 2 Gbit/sec at output powers of 20 mW were observed, waveform fidelity was fully adequate for low BER data transmission, and wavefront measurements showed that phase aberrations were less than lamda/50. Also, individually addressable arrays of up to ten contiguous diode lasers were fabricated and tested. Each laser operates at powers up to 30 mW CW in single spatial mode. Shifting the operating wavelength of the basic CSP laser from 8300 A to 8650 A was accomplished by the addition of Si to the active region. Output power has reached 100 mW single mode, with excellent far field wave front properties. Operating life is currently approx. 1000 hrs at 35 mW CW. In addition, laser reliability, for operation at both 8300 A and 8650 A, has profited significantly from several developments in the processing procedures. Author

N88-17021# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Stuttgart (West Germany). Inst. fuer Technische Physik.
MODELING OF PULSED GAS FLOW LASERS
Friedrich Offenhaeuser Apr. 1987 154 p In GERMAN; ENGLISH summary Report will also be announced as translation (ESA-TT-1090)
(DFVLR-FB-87-19; ISSN-0171-1342; ETN-88-91376) Avail: NTIS HC A08/MF A01; DFVLR, Cologne, Federal Republic of Germany DM 50.50

Very complex simulation problems, occurring in the description of pulsed gas flow lasers were modeled. The fundamentals of the laser model are described. The computer code has the property that the type of laser is specified by a data file only. Hence, the laser model can be applied without changes of the computer program to all gas flow lasers whereby gas flow, optical axis, and a possible electrical excitation act perpendicularly to each other. ESA

N88-17022# Kaiserslautern Univ. (West Germany). Dept. of Physics.
INVESTIGATIONS OF SOLID STATE SLAB LASERS Final Report, 1 Oct. 1983 - 31 Mar. 1986
J. Eicher, K. Mann, and H. Weber Bonn, Federal Republic of Germany Bundesministerium fuer Forschung und Technologie 1986 210 p In GERMAN; ENGLISH summary
(Contract BMFT-13-N-5306/1)
(ETN-88-91055) Avail: NTIS HC A10/MF A01

Beam quality and efficiency of Nd slab lasers were investigated. Beam quality exceeds that of rods by a factor of 10. The efficiency of 1.4 percent (glass) and 0.8 percent (YAG) is lower than conventional systems, due to a nonadapted pumping cavity and a low extraction efficiency. Both can be improved. The gas-water cooled systems cannot be used for high average power, because the efficiency decreases rapidly with increasing temperature, less than 100 C. At high pumping levels liquid cooling is required. For an optimized Nd-YAG system of the dimensions used, an output power of max 90 W with good bean quality is possible. Although Nd-YAG is the best crystal, alexandrite is a promising candidate for slab lasers. ESA

N88-17023# Stockholm Univ. (Sweden). Inst. of Physics.
ON THE SIGNAL STRENGTH DEPENDENCY ON PRESSURE IN LASER SUB-DOPPLER SATURATION SPECTROSCOPY WITH SPECIAL ATTENTION TO GASEOUS DIATONIC MOLECULES
P. Royen Sep. 1987 15 p
(USIP-87-13; ETN-88-91672) Avail: NTIS HC A03/MF A01

Experimental conditions and expected signal strength and signal to noise ratios, when laser sub-Doppler saturation techniques are employed on gaseous diatomic molecules, are discussed. Simple evaluations and calculations, for guidance in the determination of the optimal gas pressure in laser saturation experiments, are presented. ESA

N88-17024# Centre National de la Recherche Scientifique, Marseilles (France). Inst. de Mecanique des Fluides de Marseille.
MINIMUM NECESSARY INTENSITY OF SOURCE OF PREIONIZATION FOR STABILIZATION OF A SELF-SUSTAINING LASER DISCHARGE WITH MEAN POWER RAISED BY ELECTRON BEAM OR X-RAYS
M. A. Gevaudan, M. B. Fontaine, and M. B. Forestier Jul. 1986

160 p In FRENCH Sponsored by Direction des Recherches, Etudes et Techniques, Paris, France Prepared in cooperation with Aix-Marseilles-2 Univ., France
(PB87-178158) Avail: NTIS HC E08/MF E08 CSCL 20E

The XeCl laser (wavelength = 308 nm) avalanche discharge is theoretically studied and modeled. Preionization takes place by a beam of X-rays, using energy form an assigned capacitor or a transmission line. Phenomena are discussed starting from the avalanche, the diffusion and entrainment of electrons, and the formation of the space charge fields. In the theoretical study of the active milieu of a self-sustaining laser discharge, an account was taken for the first time of variation of electron speed as a function of the variation of the electric field in the course of the breakdown process. This increased the precision of determining the necessary conditions for obtaining a homogeneous discharge. Particularly, the minimum necessary electron density of preionization and maximum permissible temperature for reaching the breakdown threshold in perfect isotropy were calculated for different types of lasers. Theoretical models of discharge circuits with capacitors and transmission lines were derived from circuit equations with constant resistance. Different utilizations of the laser discharges are considered for optimization of capacitance and impedance. GRA

N88-17025# Paris II Univ., Orsay (France). Lab. de l'Horloge Atomique.
HYDROGEN MASER Final Report
C. Audoin Oct. 1986 128 p In FRENCH Sponsored by Direction des Recherches, Etudes et Techniques, Paris, France
(PB87-171617) Avail: NTIS HC E07/MF E07 CSCL 20E

The principle of automatic tuning and the corresponding technical options are indicated; the theoretical limitations inherent in the method are outlined. The fast automatic tuning system (accomplished on two samples) is described in detail. Its behavior coincides with the theory. The measuring results of stability confirm the improvement in performance and the validity of the method. Author

N88-17026# Lawrence Livermore National Lab., Calif.
INTRINSIC CORRECTIONS TO OPTICAL GUIDING IN A FREE-ELECTRON LASER: BEAM RESEARCH PROGRAM
Yu-Jiuan Chen, E. T. Scharlemann, and A. M. Sessler 1987 17 p Presented at the 9th International Free-Electron Laser Conference, Williamsburg, Va., 14 Sep. 1987 Prepared in cooperation with California Univ., Berkeley, Lawrence Berkeley Lab.
(Contract W-7405-eng-48)
(DE88-002667; UCRL-95623-Rev-1; CONF-8709110-14-Rev-1) Avail: NTIS HC A03/MF A01

The effect on optical guiding of the undulations of an electron beam in a free electron laser (FEL) is investigated. A model for a fully saturated FEL amplifier with no remaining gain is developed. The density of the electron beam includes the effects of both transverse and longitudinal undulation. The longitudinal density modulation is expressed in terms of the Bessel functions of zeta, where zeta = a(sub w)/2(1 + a(sub w)) is the shift of the electron phase in the electron bucket caused by its longitudinal undulation. The transverse density modulation is evaluated to second order in the ratio of undulation amplitude delta r to beam radial scale length r(sub b). The radiation field is calculated in terms of spatial modes proportional to exp(i(k + delta k + lk(sub w)z - iwt)), where l is an arbitrary integer. Here, delta k is the change of the wavenumber of the radiation caused by the electron bunches. Radially radiating modes with intensity on the order of (delta k/k(sub w))zeta sup 2 are found. Optical guiding is modified by the transverse undulations of the beam at second order in delta r(sub b), and by the longitudinal undulations to first order in delta k/k (sub w). For the usual FEL parameters, the correction is quite small. DOE

N88-17027# Argonne National Lab., Ill.
LASER POST-IONIZATION SECONDARY NEUTRAL MASS SPECTROSCOPY
D. M. Gruen, M. J. Pellin, W. F. Calaway, and C. E. Young 1987 9 p Presented at the 6th International Conference on Secondary Ion Mass Spectrometry - SIMS 6, Versailles, France, 13 Sep. 1987
(Contract W-31-109-eng-38)
(DE88-002979; CONF-8709132-3) Avail: NTIS HC A02/MF A01

Three different instruments using laser ionization techniques will be described. Results from the SARISA instrument with a demonstrated figure of merit of .05 (atoms detected/atoms sputtered) for resonance ionization; detection of Fe at the sub-part-per-billion level in ultrapure Si; and features of the instrument such as energy and angle refocusing time-of-flight (EARTOF) mass spectrometer and multiplexing for simultaneous detection of secondary ions and neutrals. DOE

N88-17028# Argonne National Lab., Ill.
PICOSECOND LASER SPECTROSCOPY OF CHARGE-SEPARATION IN PHOTOSYNTHETIC MODEL SYSTEMS
T. J. Schaafsma, U. Hofstra, R. B. M. Koehorst, G. M. Sanders, and H. C. vanderPlas 1987 3 p Presented at the Conference on Modern Methods of Laser Spectroscopy of Molecules in Low Temperature Media, Tallinn, USSR, 18 May 1987 Prepared in cooperation with State Agricultural Univ., Wageningen, Netherlands
(Contract W-31-109-eng-38)
(DE88-003122; CONF-8705225-1) Avail: NTIS HC A02/MF A01

Charge-separation in synthetic donor-pigment-acceptor (DPA) compounds and concentration dimers of porphyrins was investigated by fluorescence quenching, EPR-spectroscopy and picosecond optical absorption spectroscopy. DOE

N88-17029# Los Alamos National Lab., N. Mex.
MODE MEDIA INTERACTIONS IN AN FEL (FREE ELECTRON LASER)
S. J. Gitomer, S. C. Bender, and B. D. McVey 1987 37 p Presented at the 9th International Free-Electron Laser Conference, Williamsburg, Va., 14 Sep. 1987
(Contract W-7405-eng-36)
(DE88-003155; LA-UR-87-3929; CONF-8709110-12) Avail: NTIS HC A03/MF A01

The e-beam gain and refractive properties in an FEL alters the optical mode behavior from that of a bare resonator. Reported here are 3-D simulations with FELEX and experiments on the 10.6 micron wavelength Los Alamos FEL performed to assess the importance of this effect for a range of e-beam parameters. Two sets of measurements are made for a near concentric cavity with optical axis displaced from the electron beam axis. The first is a static measurement made during cavity mode saturation of the optical beam centroid referred to each resonator mirror. The optical detector scheme for this part of the experiment uses a 256 element integrating pyroelectric array. The second is a dynamic measurement made during cavity mode decay of the motion of the optical beam centroid and waist referred to each resonator mirror. The optical detection scheme for this part of the experiment consists of a three-part split mirror detector viewing two different optical paths. These measurements quantify the gain and refractive properties of the electron beam when compared to FELEX simulations. Implications for FEL alignment schemes and future high-power FELs are discussed. DOE

N88-17030# Oak Ridge National Lab., Tenn.
THE SUPPRESSION OF STIMULATED HYPER-RAMAN EMISSION IN Na DUE TO PARAMETRIC FOUR-WAVE MIXING
M. A. Moore, W. R. Garrett, and M. G. Payne Nov. 1987 4 p Presented at the 3rd International Laser Science Conference, Atlantic City, N.J., 1 Nov. 1987
(Contract DE-AC05-84OR-21400)
(DE88-003290; CONF-871147-1) Avail: NTIS HC A02/MF A01

We show that an interference effect involving four-wave mixing can almost totally suppress predicted examples of stimulated

hyper-Raman emission in the forward direction of a laser pump beam. The effect is demonstrated in Na vapor. DOE

N88-17031# Los Alamos National Lab., N. Mex.
PULSED LASER STEREOPHOTOGRAPHY OF PLASMAS AND DYNAMICALLY MOVING SURFACES
D. L. Paisley 1987 6 p Presented at the 31st SPIE Annual International Technical Symposium on Optical and Optoelectronic Applied Science and Engineering, San Diego, Calif., 16 Aug. 1987
(Contract W-7405-eng-36)
(DE88-003170; LA-UR-87-3767; CONF-8708110-27) Avail: NTIS HC A02

A pulsed laser is used as a light source for illuminating the surface of a dynamic event of less than or equal to 1 sq mm moving at greater than 3 mm/microsec. At a predetermined time during the dynamic action, a stereo camera is used to record a pair of images of the dynamically moving surface. The stereoimage pair can be quantified for surface contour. DOE

N88-17032# Stanford Linear Accelerator Center, Calif.
A CRUDE SCALING LAW FOR LASERTRONS
J. Rees Nov. 1987 4 p
(Contract DE-AC03-76SF-00515)
(DE88-003880; SLAC/AP-60) Avail: NTIS HC A02/MF A01

The lasertron is under consideration in several laboratories as a promising new source of high-power microwaves that is competitive with conventional klystrons in its properties - particularly in efficiency. In this note, a crude scaling law for high-power lasertrons is derived based on the observation that the main limiting phenomenon, the phenomenon that curtails the tube's efficiency, is debunching due to longitudinal space-charge forces acting in the electron gun. The scaling law indicates that lasertrons are quite restricted in the power they can generate at high frequencies. DOE

N88-17404# Joint Publications Research Service, Arlington, Va.
MIRRORS FOR HIGH-POWER CONTINUOUS-WAVE Ar-LASERS Abstract Only
N. D. Goldina, V. I. Donin, G. N. Nikolayev, and T. T. Timofeyev *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 27 Oct. 1987 p 10 Transl. into ENGLISH from Kvantovaya Elektronika (Moscow, USSR), v. 14, no. 3, Mar. 1987 p 564-573 Original language document was announced in IAA as A87-43550 (For primary document see N88-17395 09-70)
Avail: NTIS HC A04/MF A01

N88-17405# Joint Publications Research Service, Arlington, Va.
SEMICONDUCTOR LASER WITH ELECTRON-BEAM PUMPING AND FIBER-OPTIC OUTPUT WAVEGUIDE Abstract Only
I. G. Goncharov and A. A. Kirillovich *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 27 Oct. 1987 p 18-19 Transl. into ENGLISH from Kvantovaya Elektronika (Moscow, USSR), v. 14, no. 1, Jan. 1987 p 94-99 Original language document was announced in IAA as A87-38314 (For primary document see N88-17395 09-70)
Avail: NTIS HC A04/MF A01

N88-17411# Joint Publications Research Service, Arlington, Va.
STATISTICS OF BREAKDOWN CENTERS APPEARING DURING PROPAGATION OF LASER RADIATION THROUGH TURBULENT ATMOSPHERE Abstract Only
M. S. Belenkiy, Yu. D. Kopytin, and S. T. Penin *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 27 Oct. 1987 p 29 Transl. into ENGLISH from Izvestiya Vysshikh Uchebnykh Zavedeniy: Fizika (Tomsk, USSR), v. 30, no. 2, Feb. 1987 p 75-79 (For primary document see N88-17395 09-70)
Avail: NTIS HC A04/MF A01

N88-17412# Joint Publications Research Service, Arlington, Va.
MODE LOCKING IN Nd-LASER BY MEANS OF Gd-Sc-Ga-GARNET SHUTTER Abstract Only
M. I. Demchuk, Ye. V. Zharikov, A. M. Zabaznov, I. A. Manichev, V. P. Mikhaylov, A. M. Prokhorov, A. P. Shkadarevich, A. F. Chernyakovskiy, I. A. Shcherbakov, and K. V. Yumashev *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 27 Oct. 1987 p 30 Transl. into ENGLISH from Kvantovaya Elektronika (Moscow, USSR), v. 14, no. 2, Feb. 1987 p 423-424 Original language document was announced in IAA as A87-43532 (For primary document see N88-17395 09-70)
Avail: NTIS HC A04/MF A01

N88-17413# Joint Publications Research Service, Arlington, Va.
LASER SIMULATION OF LIGHT AND PLASMA ACTION ON COMETS AND PLANETS Abstract Only
G. A. Askaryan and I. M. Rayevskiy *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 27 Oct. 1987 p 30-31 Transl. into ENGLISH from Kvantovaya Elektronika (Moscow, USSR), v. 14, no. 2, Feb. 1987 p 229-230 Original language document was announced in IAA as A87-43501 (For primary document see N88-17395 09-70)
Avail: NTIS HC A04/MF A01

N88-17414# Joint Publications Research Service, Arlington, Va.
HIGH-POWER PERIODIC-PULSE YAG:Nd3+-LASER SYSTEM WITH TELESCOPIC UNSTABLE RESONATOR AND TWO-STAGE AMPLIFIER Abstract Only
P. A. Apanasevich, V. V. Kvach, V. G. Koptev, V. A. Orlovich, A. A. Stavrov, and A. P. Shkadarevich *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 27 Oct. 1987 p 31 Transl. into ENGLISH from Kvantovaya Elektronika (Moscow, USSR), v. 14, no. 2, Feb. 1987 p 265-270 Original language document was announced in IAA as A87-43506 (For primary document see N88-17395 09-70)
Avail: NTIS HC A04/MF A01

N88-17415# Joint Publications Research Service, Arlington, Va.
TUNABLE Al2O3:Ti3+-LASER WITH OPTICAL PUMPING Abstract Only
Kh. S. Bagdasarov, V. P. Danilov, T. M. Murina, Ye. G. Novikov, A. M. Prokhorov, V. B. Semenov, and Ye. A. Fedorov *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 27 Oct. 1987 p 32 Transl. into ENGLISH from Pisma v Zhurnal Tekhnicheskoy Fiziki (Leningrad, USSR), v. 13, no. 6, 26 Mar. 1987 p 369-371 (For primary document see N88-17395 09-70)
Avail: NTIS HC A04/MF A01

N88-17416# Joint Publications Research Service, Arlington, Va.
VISIBLE InGaAsP/GaAsP LASERS PRODUCED BY EPITAXIAL GROWTH FROM LIQUID PHASE Abstract Only
Zh. I. Alferov, I. N. Arsentyev, D. Z. Garbuzov, N. A. Strugov, A. V. Tikunov, and Ye. I. Chudinova *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 27 Oct. 1987 p 32-33 Transl. into ENGLISH from Pisma v Zhurnal Tekhnicheskoy Fiziki (Leningrad, USSR), v. 13, no. 6, 26 Mar. 1987 p 372-374 (For primary document see N88-17395 09-70)
Avail: NTIS HC A04/MF A01

N88-17417# Joint Publications Research Service, Arlington, Va.
DYE LASERS PUMPED BY RADIATION FROM HIGH-POWER SEMICONDUCTOR LASERS Abstract Only
O. V. Bogdankevich, M. M. Zverev, Ye. M. Krasavina, I. V. Kryukova, and V. F. Pevtsov *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 27 Oct. 1987 p 33 Transl. into ENGLISH from Kvantovaya Elektronika (Moscow, USSR), v. 14, no. 1, Jan. 1987 p 218-219 Original language document was announced in IAA as A87-38336 (For primary document see N88-17395 09-70)
Avail: NTIS HC A04/MF A01

N88-17418# Joint Publications Research Service, Arlington, Va.
CONTINUOUSLY FREQUENCY-TUNABLE HIGH-PRESSURE CO2-LASER WITH PLASMATIC CATHODE Abstract Only
N. V. Karlov, A. V. Kisletsov, I. O. Kovalev, G. P. Kuzmin, A. A. Nesterenko, and E. M. Khokhlov *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 27 Oct. 1987 p 34 Transl. into ENGLISH from Kvantovaya Elektronika

(Moscow, USSR), v. 14, no. 1, Jan. 1987 p 216-218 Original language document was announced in IAA as A87-38335 (For primary document see N88-17395 09-70)
Avail: NTIS HC A04/MF A01

N88-17419# Joint Publications Research Service, Arlington, Va.
EFFICIENCY OF IONIC NOBLE GAS AND ALKALI METAL MOLECULES AS ULTRAVIOLET AND FAR-ULTRAVIOLET LASERS Abstract Only
N. G. Basov, M. G. Voytik, V. S. Zuyev, A. D. Klementov, V. P. Kutakhov, and S. A. Pendyur *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 27 Oct. 1987 p 34-35 Transl. into ENGLISH from Kvantovaya Elektronika (Moscow, USSR), v. 14, no. 1, Jan. 1987 p 185-187 Original language document was announced in IAA as A87-38325 (For primary document see N88-17395 09-70)
Avail: NTIS HC A04/MF A01

N88-17420# Joint Publications Research Service, Arlington, Va.
FEASIBILITY OF CHEMICAL LASERS BASED ON CHAIN REACTION INVOLVING HYDROGEN FLUORINATION WITH THERMAL BRANCHING MECHANISM Abstract Only
E. U. Baykov, A. S. Bashkin, and A. N. Orayevskiy *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 27 Oct. 1987 p 35 Transl. into ENGLISH from Kvantovaya Elektronika (Moscow, USSR), v. 14, no. 1, Jan. 1987 p 151-157 (For primary document see N88-17395 09-70)
Avail: NTIS HC A04/MF A01

N88-17421# Joint Publications Research Service, Arlington, Va.
HIGH-EFFICIENCY GaAs SEMICONDUCTOR LASER WITH LONGITUDINAL EXCITATION BY SCANNING ELECTRON BEAM Abstract Only
A. A. Gubarev, V. I. Kozlovskiy, B. M. Lavrushin, A. S. Nasibov, and P. V. Reznikov *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 27 Oct. 1987 p 36 Transl. into ENGLISH from Kvantovaya Elektronika (Moscow, USSR), v. 14, no. 1, Jan. 1987 p 170-176 Original language document was announced in IAA as A87-38324 (For primary document see N88-17395 09-70)
Avail: NTIS HC A04/MF A01

N88-17422# Joint Publications Research Service, Arlington, Va.
PERIODIC-PULSE SEMICONDUCTOR LASER WITH ELECTRON-BEAM PUMPING Abstract Only
O. V. Bogdankevich, M. M. Zverev, S. P. Kopyt, Ye. M. Krasavina, I. V. Kryukova, L. G. Novozhilova, and V. F. Pevtsov *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 27 Oct. 1987 p 37-38 Transl. into ENGLISH from Kvantovaya Elektronika (Moscow, USSR), v. 14, no. 3, Mar. 1987 p 605-607 (For primary document see N88-17395 09-70)
Avail: NTIS HC A04/MF A01

N88-17428# Joint Publications Research Service, Arlington, Va.
CHARACTERISTICS OF LASER-PLASMA X-RADIATION SOURCE (REVIEW) Abstract Only
A. V. Vinogradov and V. N. Shlyaptsev *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 27 Oct. 1987 p 51 Transl. into ENGLISH from Kvantovaya Elektronika (Moscow, USSR), v. 14, no. 1, Jan. 1987 p 5-26 Original language document was announced in IAA as A87-38304 (For primary document see N88-17395 09-70)
Avail: NTIS HC A04/MF A01

37 MECHANICAL ENGINEERING

Includes auxiliary systems (nonpower); machine elements and processes; and mechanical equipment.

N88-17033# Naval Postgraduate School, Monterey, Calif.
DEVELOPMENT OF METHODS FOR LOW TEMPERATURE DIFFUSION BONDING M.S. Thesis
Paul A. Muffler Sep. 1987 39 p
(AD-A186875) Avail: NTIS HC A03/MF A01 CSCL 11F

An apparatus for low temperature diffusion bonding of dissimilar metals has been developed. Experiments varying the bonding temperature at constant pressure and time were conducted utilizing type 316 stainless steel samples coated with a layer of silver in order to verify the design of the apparatus and the bonding procedures. The Scanning Electron Microscope (SEM) was used to illustrate the effects of temperature variation on the microstructure of the bonds produced. The results showed diffusion bonds of silver to silver to be possible at all three temperatures used. Recrystallization and or grain growth in the silver coating occurred at the bond interface at 300 C and the entire coating was beginning to recrystallize and undergo grain growth at 400 C after 30 minutes at 20,000 psi (137.9 MPa). The experiments successfully demonstrated the capability of the apparatus, but much more development of the bonding procedure is required. GRA

N88-17034# Electronics Research Lab., Adelaide (Australia).
DESIGN AND CHARACTERISTICS OF A LIQUID AEROSOL GENERATOR
S. S. Ti and J. D. Ingram Apr. 1987 25 p
(AD-A186942; ERL-0412-TM; DODA-AR-004-942) Avail: NTIS HC A03/MF A01 CSCL 13G

A liquid aerosol generator of the dispersion type was designed, constructed and calibrated. For the polydisperse kerosene aerosols, the mean droplet diameters were found to be inversely proportional to the vapor pressures. GRA

N88-17035# Naval Postgraduate School, Monterey, Calif.
CONTROL SYSTEM SIMULATION FOR A SINGLE-LINK FLEXIBLE ARM M.S. Thesis
Ki S. Park Sep. 1987 88 p
(AD-A187037) Avail: NTIS HC A05/MF A01 CSCL 13G

To control a lightweight manipulator, a validated dynamic model based on the Equivalent Rigid Link System (ERLS) is used to formulate a control algorithm. The required torque to drive the manipulator to a desired angle is calculated. Since the control system includes an electrohydraulic actuator, the required current is also calculated by the inverse dynamics of the hydraulic servo. A computerized simulation is performed with various loading conditions, gain values, and desired angles. GRA

N88-17036# British Aerospace Dynamics Group, Stevenage (England). Space and Communications Div.
DESIGN FEASIBILITY REPORT ON INVESTIGATION OF MAGNETIC BEARINGS FOR THE OCEAN COLOUR MONITOR RADIOMETER SCANNER
G. Bearzot Paris, France ESA Feb. 1981 145 p
(Contract ESTEC-4330/80-NL-PP(SC))
(BAe-TP-7849; ESA-CR(P)-1414; ETN-87-90507) Copyright
Avail: NTIS HC A07/MF A01

Magnetic bearing configurations for use in a scanner mechanism are considered. The scanner supports and rotates a 7 kg elliptical mirror which is intended for use in an ocean color monitor radiometer. The supporting and rotating functions are subject to very stringent stability requirements. The chosen solution employs a two degree of freedom magnetic bearing at the front end of the device and a small precision ball bearing at the rear. It theoretically meets the stability requirements and compares very favorably with ball bearing and all magnetic bearing solutions. Author (ESA)

N88-17037# European Space Tribology Lab., Risley (England).
[ACTIVITIES REPORT IN TRIBOLOGY] Progress Report, 1986
M. J. Todd Paris, France ESA Feb. 1987 15 p
(Contract ESTEC-5615/83-NL-PP)
(ESA-ESTL-79; ESA-CR(P)-2477; ETN-88-91423) Avail: NTIS HC A03/MF A01

Tribological examinations involving lead films, electric contacts, oils and greases, MoS2 films, and gears are summarized. Data processing, and cryogenic tribology are described. ESA

N88-17038# European Space Tribology Lab., Risley (England).
SEVEN YEAR THERMAL VACUUM REAL LIFE TEST OF A MEDIUM SPEED (DESPIN) MECHANISM MANUFACTURED BY DORNIER SYSTEM
K. Parker Paris, France ESA Mar. 1987 67 p
(Contract ESA-2584/75)
(ESA-ESTL-64; ESA-CR(P)-2478; ETN-88-91424) Avail: NTIS HC A04/MF A01

A satellite despin mechanism succesfully completed a 7 yr thermal vacuum real life test, extended by 1 yr operation at nominal ambient temperature. During the 7 yr test the thermal conditions were changed at four-weekly intervals to simulate the flight conditions, at a mechanism speed of 60 rpm. Earth eclipses were simulated at six-monthly intervals. Grease/oil lubrication was used. There is a gradual increase in the current demanded by the motor to enable the speed control system to maintain a constant speed. This is not due to an increase in friction torque within the mechanism, but to a progressive reduction in the field strength of the motor rotor permanent magnets due to aging. The thermal distribution within the mechanism remains constant except that during eclipse simulations towards the end of the test motor power dissipation increases slightly. ESA

N88-17039# Technische Hogeschool, Delft (Netherlands). Lab. for Automation of Production and for Mechanisms.
KINEMATIC OPTIMIZATION OF MECHANISMS, A FINITE ELEMENT APPROACH Ph.D. Thesis
Antonius Johannes Kl Breteler 1987 151 p
(ISBN-90-370-0012-6; ETN-88-91612) Avail: NTIS HC A08/MF A01

A finite element (FEM) optimization approach to designing link mechanisms, which calculates the kinematic parameters for a given motion problem is considered. The feasibility of the kinematic parameter space is treated. It is demonstrated that singularity of the continuity matrix in the FEM yields an exact expression for the boundary. For optimization purposes all derivatives, required to calculate the gradient of the error function (least squares type) and the boundary function, are expressed exactly in terms of the FEM definition of transfer functions. The theory was programmed to handle almost any kinematic synthesis problem reliably, efficiently, and accurately. The definition of the mechanism and the motion problem is done at input level by means of tables (no formulas required). Synthesis problems solved successfully with the program are reported. ESA

N88-17040# Institut Franco-Allemand de Recherches, St. Louis (France).
NEW MODEL TO ESTIMATE THE PERFORATION POWER OF KINETIC ENERGY PROJECTILES
E. Wollmann and G. Weihrauch 3 Sep. 1986 15 p Presented at the 9th International Symposium on Ballistics, Shrivenham, United Kingdom, 1 May 1986 Sponsored by Direction des Recherches, Etudes et Techniques, Paris, France
(PB87-166757; ISL-CO-234-86) Avail: NTIS HC E03/MF E03 CSCL 13I

The perforation model treats the projectile as a mushrooming cylinder penetrating a target which is defined by a resistance interacting with the head of the projectile. A one-dimensional finite difference method is used to describe the deformation of the projectile, whereas the target resistance is formulated analytically. In the interface between projectile and target an erosion condition is postulated which extrudes elements from the uniaxial problem if strain exceeds a maximum value. Empirical formulations describe bending and fragmentation of the projectile on the rear of the plate. GRA

N88-17041# Oak Ridge National Lab., Tenn.
GAS EROSION OF IMPELLER HOUSING IN THE OPERATION OF A HIGH-TEMPERATURE, HIGH-PRESSURE HELIUM CIRCULATOR
J. P. Sanders, R. L. Heestand, and H. C. Young 1987 15 p Presented at the Meeting on Gas-cooled Reactor Coolant Circulator and Blower Technology, San Diego, Calif., 30 Nov. 1987
(Contract DE-AC05-84OR-21400)
(DE88-002607; CONF-8711106-1) Avail: NTIS HC A03/MF A01

Three gas-bearing circulators are installed in series in a high-pressure, high-temperature loop to provide helium flow up to 0.47 cu m/s at a total head of 78 kJ/kg. The design pressure is 10.7 MPa, and temperatures of 1000 C can be obtained in the test section. The inlet temperature to the circulators is limited to 450°C. During a routine examination of the circulator, deep V-shaped grooves were found in the stationary surface of this cavity. At the same time, a very fine, dark particulate was observed in crevices of the housing. At first it was assumed that the grooves were formed by particulate erosion; however, examination of the grooves and discussions with persons experienced with large circulator operation changed this opinion. Erosion caused by particulate is characteristically rounded on the bottom and has a greater width to depth aspect than the V-shaped grooves, which were observed. Analysis of the particulate indicated that it was essentially the material of the housing that had undergone reactions with impurities in the circulating gas. It was subsequently concluded that the impeller housing had not been heat treated in a sufficiently oxidizing atmosphere after machining to form an adherent oxide coating. This suboxide coating was eroded by the shear forces in the gas. The exposed layer of metal was then further oxidized by the impurities in the gas, and these layers of oxide were successively eroded to produce the grooves. This erosion problem was eliminated by machining a ring of the same material, heat treating it to form an adherent stable oxide, and bolting it in place in the cavity. DOE

N88-17042# Lawrence Livermore National Lab., Calif.
A CONTROL SYSTEM FOR MAINTAINING HIGH STABILITY IN GAS PRESSURE
C. R. Wuest and C. D. Hendricks Sep. 1987 10 p
(Contract W-7405-eng-48)
(DE88-003712; UCRL-53817) Avail: NTIS HC A02/MF A01

A pressure control system has been implemented on an experiment designed to detect the presence of fractional charges in bulk matter. The experiment utilizes a liquid-droplet generation technique requiring high-stability gas-pressure delivery to ensure accurate data collection. The pressure control system consists of a pressurized mercury reservoir containing a low-vapor-pressure, diffusion-pump oil. A commercially available differential pressure transducer, servo-driven valve, and controller sense the pressure fluctuations with respect to a static reference pressure. The system can maintain constant pressure to better than one part in 10,000 at working pressures in the range of 100 to 300 psi. DOE

N88-17043 Stanford Univ., Calif.
ADAPTIVE PROXIMATE TIME-OPTIMAL SERVOMECHANISMS Ph.D. Thesis
Michael Lee Workman [1987] 193 p
Avail: Univ. Microfilms Order No. DA8723123

In every control system, there is a limit on the magnitude of the control system. Most control systems are designed such that under normal operation the limit on the control is not reached. In the field of adaptive control, this is especially true, as on-line control law design algorithms are not sophisticated enough to do much else. An approach was developed in which the full control authority is used, rather than avoided, for a class of plants very characteristic of servomechanisms. The theory of Minimum Time Optimal Control is applied because it takes into account the limited control authority. Robustness issues are shown to exist with the ideal minimum time controller. A practical version of the minimum time controller is developed, with conditions for its stability. The advantage of adapting the system to identified plant parameters is demonstrated. An adaptive algorithm is proposed and proved to be stable and convergent. Discrete time versions of the Proximate Time Optimal Servomechanism (PTOS) and the Adaptive PTOS (APTOS) are then developed. The much more complex conditions for stability, design, and performance of the discrete time systems are also derived. Simulations of both the continuous and discrete time systems are done to demonstrate the theory

and advantages of the adaptive controller. Hardware experiments are done for the discrete time system and shown to compare well with the simulated system. Dissert. Abstr.

N88-17044# Iowa Univ., Iowa City.
A SUBSTRUCTURE METHOD FOR DYNAMIC SIMULATION OF FLEXIBLE MECHANICAL SYSTEMS WITH GEOMETRIC NONLINEARITIES Ph.D. Thesis
Shih-Chin Wu [1987] 195 p
Avail: Univ. Microfilms Order No. DA8721465

A substructure synthesis method is proposed to account for contact-impact effects in flexible components of mechanical systems. Components that may come into contact are divided into substructures, on each of which local deformation modes are defined to describe deformation fields of components. A constraint addition-deletion technique is used to account for contact between impacting bodies. Lagrange multipliers associated with the constraints, which represent constraint forces, are used to determine separation of contacting nodes. Dissert. Abstr.

N88-17045*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
DYNAMIC ANALYSIS OF MULTIMESH-GEAR HELICOPTER TRANSMISSIONS
Fred K. Choy, Dennis P. Townsend, and Fred B. Oswald Feb. 1988 22 p
(NASA-TP-2789; E-3191; NAS 1.60:2789) Avail: NTIS HC A03/MF A01 CSCL 13I

A dynamic analysis of multimesh-gear helicopter transmission systems was performed by correlating analytical simulations with experimental investigations. The two computer programs used in this study, GRDYNMLT and PGT, were developed under NASA/Army sponsorship. Parametric studies of the numerical model with variations on mesh damping ratios, operating speeds, tip-relief tooth modifications, and tooth-spacing errors were performed to investigate the accuracy, application, and limitations of the two computer programs. Although similar levels of dynamic loading were predicted by both programs, the computer code GRDYNMLT was found to be superior and broader in scope. Results from analytical work were also compared with experimental data obtained from the U.S. Army's UH-60A Black Hawk 2240-kW (3000-hp) class, twin-engine helicopter transmission tested at the NASA Lewis Research Center. Good correlation in gear stresses was obtained between the analytical model simulated by GRDYNMLT and the experimental measurements. More realistic mesh damping can be predicted through experimental data correlation. Author

N88-17073# Concordia Univ., Montreal (Quebec). Dept. of Mechanical Engineering.
DYNAMIC RESPONSE OF A GEARED TRAIN OF ROTORS SUBJECTED TO RANDOM SUPPORT EXCITATIONS
S. V. Neriya, R. B. Bhat, and T. S. Sankar *In* Shock and Vibration Information Center The Shock and Vibration Bulletin. Part 4: Structural Dynamics and Modal Test and Analysis Jan. 1987 p 107-119 (For primary document see N88-17062 09-39)
Avail: NTIS HC A07/MF A01 CSCL 13I

N88-17265*# Honeywell, Inc., Golden Valley, Minn. Corporate Systems Development Div.
IMPLEMENTATION OF A ROBOTIC FLEXIBLE ASSEMBLY SYSTEM
Ronald C. Benton *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 421-429 (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 13I

N88-17266*# SRI International Corp., Menlo Park, Calif. Robotics Lab.
SYSTEM INTEGRATION OF A TELEROBOTIC DEMONSTRATION SYSTEM (TDS) TESTBED
John K. Myers *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 433-440 (For primary document see N88-17206 09-59)
(Contract JPL-957908)
Avail: NTIS HC A23/MF A01 CSCL 13I

N88-17267*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
VISION TECHNOLOGY/ALGORITHMS FOR SPACE ROBOTICS APPLICATIONS
Kumar Krishen and Rui J. P. deFigueiredo (Rice Univ., Houston, Tex.) *In its* First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 441-453 (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 13I

N88-17268*# McDonnell-Douglas Astronautics Co., Houston, Tex. Engineering Services.
AN OPTIMAL RESOLVED RATE LAW FOR KINEMATICALLY REDUNDANT MANIPULATORS
B. J. Bourgeois *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 457-464 (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 13I

N88-17269*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
TELEROBOTIC RESEARCH AT NASA LANGLEY RESEARCH CENTER
Nancy E. Sliwa *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 465-469 (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 13I

N88-17270*# Rockwell International Corp., Downey, Calif. Space Station Systems Div.
MANIPULATOR ARM DESIGN FOR THE EXTRAVEHICULAR TELEOPERATOR ASSIST ROBOT (ETAR): APPLICATIONS ON THE SPACE STATION
Margaret M. Clarke, Charles J. Divona, and William M. Thompson (NSA Electro-Mechanidcal Systems Div., Breta, Calif.) *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 471-475 (For primary document see N88-17206 09-59)
(Contract NAS8-36629)
Avail: NTIS HC A23/MF A01 CSCL 13I

N88-17272*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
TELEROBOTIC TRUSS ASSEMBLY
Philip L. Sheridan *In its* First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 487-491 (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 13I

N88-17274*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
TELEROBOT FOR SPACE STATION
Lyle M. Jenkins *In its* First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 497-499 (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 13I

N88-17276*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
INTELLIGENT ROBOTIC TRACKER
W. S. Otaguro, L. O. Kesler (McDonnell-Douglas Astronautics Co., Huntington Beach, Calif.), K. C. Land, and D. E. Rhoades *In its* First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 513-517 (For primary

document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 13I

38 QUALITY ASSURANCE AND RELIABILITY

Includes product sampling procedures and techniques; and quality control.

N88-17046# Wayne State Univ., Detroit, Mich.
THERMAL WAVE IMAGING Final Report, 15 Aug. 1984 - 30 Sep. 1987
R. L. Thomas, L. D. Favro, and P. K. Kuo 30 Oct. 1987 32 p
(Contract DAAG29-84-K-0173)
(AD-A186810; ARO-21490.19-MS) Avail: NTIS HC A03/MF A01 CSCL 14B

Several aspects of thermal wave techniques for imaging defects and characterizing material properties have been studied during the course of this contract. Among the thermal wave detection techniques which were investigated are the mirage-effect (optical probe beam), the thermoacoustic effect, photothermal reflectance, and infrared (IR) video lock-in imaging. Both experiment and theory have been studied, and applications made to crack-detection, layered structures and delaminations, semiconductor devices, and contactless measurements of thermal diffusivities. GRA

N88-17047# Naval Postgraduate School, Monterey, Calif.
A COMPARISON OF MEASUREMENTS FROM THE A/E35U-3 AND PWMA (PORTABLE WEAR METAL ANALYZER) SPECTROMETERS M.S. Thesis
James T. Stewart Sep. 1987 77 p
(AD-A186855) Avail: NTIS HC A05/MF A01 CSCL 14B

This thesis examines spectrometric oil analysis data from the A/E35U-3 and the Portable Wear Metal Analyzer (PWMA). Data from the two instruments is compared using simple linear regression analysis to obtain equations that can be used to convert the A/E35U-3 values to PWMA values. The current Joint Oil Analysis Program (JOAP) Laboratory Manual is based on A/E35U-3 measurement values and is used as an aid in determining the condition of lubricated engine components. The lack of a counterpart manual for the newly introduced PWMA makes it mandatory that values based on the A/E35U-3 have a conversion to values based on the PWMA. Through transformation equations to be developed in this paper, it will be possible for the PWMA user to utilize the current laboratory manual until a manual based on PWMA values is released. GRA

N88-17048# Army Materiel Systems Analysis Activity, Aberdeen Proving Ground, Md.
MAXIMUM LIKELIHOOD ESTIMATES FOR THE DISCRETE APPLICATION OF THE AMSAA GROWTH MODEL
William P. Clay Apr. 1987 24 p
(AD-A186921; AMSAA-TR-433) Avail: NTIS HC A03/MF A01 CSCL 14D

The U.S. Army Material Systems Analysis Activity (AMSAA) reliability growth model was developed under the leadership of Dr. Larry Crow during the mid to late 1970's. The resultant model was incorporated into Military Handbook 189, Reliability Growth Management, where it is fully explained. The model as developed by Dr. Crow is intended for use with continuous data. However, Dr. Crow later developed an as yet unpublished technique for applying the model to discrete data. Briefly, this technique assigns a sequence number to each trial of the test and uses these sequence numbers as the measures of time in the model. The growth parameters are estimated from the actual test data (the number of test intervals, the number of trials in each interval, and the number of failures in each interval) by the maximum likelihood method. If the resultant likelihood equation had a true maximum, then any of several search algorithms could be applied to find it. However, as will be shown later, the likelihood equation can, in certain regions, be unbounded. The problem only becomes solvable if the maximum over a restricted region is sought. The purpose of this report is to present a solution to the problem and a computer program that implements that solution. GRA

N88-17049# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Systems and Logistics.
ANALYSIS OF THE RELIABILITY OF ROYAL AUSTRALIAN AIR FORCE NON-DESTRUCTIVE INSPECTION M.S. Thesis
Mark Cassidy Sep. 1987 96 p
(AD-A186979; AFIT/GLM/LSMA/87S-11) Avail: NTIS HC A05/MF A01 CSCL 14B

The purpose of this research was to establish, via examination of the available literature, and appropriate means of quantifying the reliability of Non-Destructive Inspection (NDI) as practiced by the Royal Australian Air Force (RAAF) NDI technicians. Further, actual measurement of this NDI reliability was to be attempted and the correlation, if any, between the NDI technician's reported and measured results and the actual flaw lengths was to be established. GRA

N88-17050# United Kingdom Atomic Energy Authority, Harwell (England). Instrumentation and Applied Physics Div.
PLASMA AND ION ETCHING FOR FAILURE ANALYSIS. PART 2. THE ETCHING OF PLASTIC ENCAPSULANT AND OTHER SEMICONDUCTOR DEVICE MATERIALS, USING THE TECHNICS GIGA ETCH 100-E PLASMA ETCH SYSTEM
M. Hardman, D. Mapper, J. Farren, and J. H. Stephen Paris, France ESA Apr. 1986 63 p
(Contract ESA-5796/84-NL-AB)
(AERE-R12212; ESA-CR(P)-2490; ETN-88-91701) Copyright Avail: NTIS HC A04/MF A01

Plastic encapsulant, silicon, silicon dioxide, silicon nitride, and polyimide were plasma etched. Results show that the die of a plastic packaged integrated circuit can be exposed using an oxygen/carbon tetrafluoride plasma, without degrading the functionality of the device. The same process gases are shown to be capable of etching silicon, silicon dioxide, and silicon nitride. Optical emission spectroscopy was used to study the plasma during the etching of these materials. Polyimide was also etched by these gases and the etch rates for various percentage mixtures of oxygen and carbon tetrafluoride were measured. The highest achievable polyimide etch rate is 120 microns/hr with an 87 percent O2/13 percent CF4 plasma. ESA

N88-17051# Construcciones Aeronauticas S.A., Madrid (Spain).
ULTRASONIC INSPECTION OF ADVANCED CFRP STRUCTURES BY COMPUTER-CONTROLLED, PULSE-ECHO TECHNIQUE
B. Sainz, V. Cortes, C. Valdecantos, and J. M. Bernardo 1987 7 p Presented at the 4th European Conference on Non-Destructive Testing, London, United Kingdom, 13-18 Sep. 1987
(ETN-88-91665) Avail: NTIS HC A02/MF A01

A portable unit to be applied in automatic inspection of advanced CFRP structures was developed to assist in artificial defect monitoring along the fatigue test of a complex component. Main features of the system are: pulse echo, water squirter operation; portable frame for X-Y scanning; maximum area of scan 600 mm (X), 400 (Y); 500 mm/sec maximum scanning speed in X direction; data of amplitude and time of flight capture capabilities; real time data acquisition and display; and software to perform data analysis. Flat and focused transducers were successfully tested. Examples of C records illustrate capabilities. A system to monitor defects not accessible from the outside when the structure is fully assembled is also described. ESA

N88-16739# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Product Assurance Div.
ESTEC'S PRODUCT ASSURANCE ACTIVITIES
D. A. Nutt *In its* ESA Bulletin No. 10 Aug. 1977 p 66-71
(For primary document see N88-16728 09-12)
Avail: NTIS HC A05/MF A01

N88-17240*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
CONFIG: QUALITATIVE SIMULATION TOOL FOR ANALYZING BEHAVIOR OF ENGINEERING DEVICES
Jane T. Malin, Bryan D. Basham, and Richard A. Harris (Mitre Corp., Houston, Tex.) *In its* First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 247-252 (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 14D

39 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; and thermal stress.

For applications see *05 Aircraft Design, Testing and Performance* and *18 Spacecraft Design, Testing and Performance*.

N88-17052# Laboratorio de Computacao Cientifica, Rio de Janeiro (Brazil).
SUCCESSFUL MIXED FORMULATION FOR AXISYMMETRIC SHELL ANALYSIS EMPLOYING DISCONTINUOUS STRESS FIELDS OF THE SAME ORDER AS THE DISPLACEMENT FIELD
A. F. D. Loula, I. Miranda, T. J. R. Hughes, and L. P. Franca 1986 1 p Presented at the 4th Brazilian Symposium on Piping and Pressure Vessels, Salvador, Brazil, 28 Oct. 1986
(DE88-700021; INIS-BR-781; CONF-8610317-7-Summ) Avail: NTIS (US Sales Only) HC A02/MF A01

Consistently perturbing the Galerkin formulation, a new Petrov-Galerkin formulation is derived for axisymmetric shells with deformation. The present method overcomes shear and membrane locking, which afflicts the classical Galerkin method. Furthermore, stability and additional accuracy are gained from thin to moderately thick shells, as shown in some representative numerical tests.
DOE

N88-17053# Shock and Vibration Information Center (Defense), Washington, D. C.
THE SHOCK AND VIBRATION BULLETIN. PART 2: INSTRUMENTATION, SHOCK ANALYSIS, AND SHOCK TESTING Monthly Report
Jan. 1987 171 p Presented at the 57th Symposium on Shock and Vibration, New Orleans, La., 14-16 Oct. 1986
(AD-A186749; SVIC-Bull-57-Pt-2) Avail: NTIS HC A08/MF A01 CSCL 20K

Fourteen papers addressing various topics in vibration and shock instrumentation, structural shock analysis, and shock response testing are compiled. Some specific areas of study include evaluation methods for accelerometers and sensor layouts, a retarded potential technique applied to shock loading of submerged structures, ballistic rocket sled testing, and pyrotechnic shock from spacecraft separation joints and pin-pullers. For individual titles, see N88-17054 through N88-17061.

N88-17054# Naval Ship Research and Development Center, Bethesda, Md. Underwater Explosions Research Div.
AN INTEGRATION TEST FOR ACCELEROMETER EVALUATION **c35**
Eric C. Hansen *In* Shock and Vibration Information Center The Shock and Vibration Bulletin. Part 2: Instrumentation, Shock Analysis and Shock Testing Jan. 1987 p 1-10 (For primary document see N88-17053 09-39)
Avail: NTIS HC A08/MF A01 CSCL 14B

A simple means for quickly evaluating accelerometers for integrability is presented in detail. In this method the accelerometer is subjected to an unsymmetrical input and the resulting output is integrated and compared to a known result. Theoretical aspects of this test are discussed and a mechanical device coupled with an electronic integrator is described to illustrate a useful test system. Using this equipment, test results from selected accelerometers are shown to demonstrate the method. Author

N88-17055# Sandia National Labs., Albuquerque, N. Mex.
SPECTRAL DENSITY ESTIMATES OF COARSELY QUANTIZED RANDOM VIBRATION DATA
Thomas J. Baca *In* Shock and Vibration Information Center The Shock and Vibration Bulletin. Part 2: Instrumentation, Shock Analysis and Shock Testing Jan. 1987 p 11-20 (For primary document see N88-17053 09-39)
(Contract DE-AC-76DP-00789)
Avail: NTIS HC A08/MF A01 CSCL 20K

The measurement of random vibration environments during flight testing of aerospace vehicles is usually accomplished by broadcasting analog signals via telemetry from the flight vehicle to a receiving station on the ground. At Sandia National Laboratories, digital telemetry systems are becoming attractive alternatives to traditional analog systems because they eliminate transmission noise and make more efficient use of telemetry bandwidth. A crucial decision must be made during the design of a digital telemetry system regarding the minimum number of bits in the word representing the digitized vibration signal. Utilizing fewer bits increases quantizing error but allows a greater number of measurement channels to be handled by the telemetry system. The objective of this paper is to assess the effect of low quantizing rates on auto-spectral density (ASD) estimates made on random vibration data. A 4-bit quantization scheme was evaluated by comparing the time histories and ASD estimates of the 4-bit data with those of the original data and an 8-bit version of the data. Three different types of random data were used for the comparison: (1) bandlimited white noise; (2) narrowband random; and (3) actual random vibration data obtained from an actual flight test utilizing a telemetry system. The study reveals that surprisingly accurate ASD estimates made using 4-bit data retain both the amplitude and frequency characteristics of the ASD of the original data. A simple reconstruction technique is introduced which makes the 4-bit quantized time history look more realistic. Author

N88-17056# Naval Sea Systems Command, Washington, D.C.
A QUANTITATIVE METHOD FOR EVALUATING SENSOR LAYOUTS **c35**
T. F. Chwastyk and D. G. Rapp (Westinghouse Electric Corp., West Mifflin, Pa.) *In* Shock and Vibration Information Center The Shock and Vibration Bulletin. Part 2: Instrumentation, Shock Analysis and Shock Testing Jan. 1987 p 21-54 (For primary document see N88-17053 09-39)
Avail: NTIS HC A08/MF A01 CSCL 14B

This paper gives a quantitative method for evaluating the use of sensors widely distributed over a structure to confirm and measure the amplitude of the dominant loading response patterns predicted by analysis. Application of this method to plausible traditional sensor layouts often shows surprisingly inefficient use of sensor channel capacity. Improved sensor layouts are readily achieved. The use of this method allows designing sensor layouts to guard against isolated errors either in sensor performance or in modeling. It also allows ready extrapolation of sensor results to uninstrumentable areas, with a quantitative estimate of the uncertainty in estimated values due to sensor noise or modeling inaccuracy. Author

N88-17057# Defence Research Establishment Suffield, Ralston (Alberta).
A SUMMARY OF EXPERIMENTAL RESULTS ON SQUARE PLATES AND STIFFENED PANELS SUBJECTED TO AIR-BLAST LOADING
R. Houlston and J. E. Slater *In* Shock and Vibration Information Center The Shock and Vibration Bulletin. Part 2: Instrumentation, Shock Analysis and Shock Testing Jan. 1987 p 55-67 (For primary document see N88-17053 09-39)
Avail: NTIS HC A08/MF A01 CSCL 20K

In combat operations, warships could be subjected to air blast and underwater shock loads capable of causing significant local damage. As part of a vulnerability and survivability study to improve Canadian warship design standards, square steel plates and stiffened panels were instrumented with pressure gauges, strain gauges, accelerometers, and displacement gauges, and then

exposed to air-blast waves of various magnitudes and durations. The experimental results obtained for the square plates and for the first stiffened panel are summarized. Author

N88-17058# Martin Marietta Corp., Baltimore, Md.
RETARDED POTENTIAL TECHNIQUE APPLIED FOR SHOCK WAVE LOADING OF DOUBLY SYMMETRIC SUBMERGED STRUCTURES
W. W. Webbon and M. Tamm (Naval Research Lab., Washington, D.C.) *In* Shock and Vibration Information Center The Shock and Vibration Bulletin. Part 2: Instrumentation, Shock Analysis and Shock Testing Jan. 1987 p 89-98 Sponsored by Office of Naval Research, Washington, D.C. (For primary document see N88-17053 09-39)
Avail: NTIS HC A08/MF A01 CSCL 20K

A three-dimensional application of the Kirchhoff retarded potential integral equation referred to as the Retarded Potential Technique is combined with the finite element structural analysis program ADINA. The combined method is used to predict the transient response of an elastic spherical shell immersed in fluid to an incident plane step pressure pulse. Predictions compare well with known series solutions for the response although divergence of the predicted responses occurs at later times. The method may be applied directly for non-spherical doubly symmetric structures with a continuous fluid-structure interface modeled with ADINA shell finite elements. Author

N88-17059# Sandia National Labs., Albuquerque, N. Mex.
HIGH-VELOCITY REVERSE BALLISTIC ROCKET SLED TESTING AT SANDIA NATIONAL LABORATORIES c09
R. D. M. Tachau *In* Shock and Vibration Information Center The Shock and Vibration Bulletin. Part 2: Instrumentation, Shock Analysis and Shock Testing Jan. 1987 p 99-104 Previously announced as N87-19423 (For primary document see N88-17053 09-39)
Avail: NTIS HC A08/MF A01 CSCL 14B

The design of an impact-fuzed weapon is dependent on accurate and predictable information about its behavior in an impact environment. Results from full scale impact tests are essential in developing and verifying computer codes which model the crush-up of these weapons. This paper discusses the reverse ballistic impact test procedure and the advantages it offers over more conventional test methods for obtaining impact test results. Also described are recent developments in the use of rocket sleds to push reverse ballistic impact targets faster than ever before. Author

N88-17060# Sandia National Labs., Albuquerque, N. Mex.
MECHANICAL IMPACT: THEORETICAL SIMULATION AND CORRELATION
G. L. Ferguson, L. C. Mixon, and F. W. Shearer (Test Group, 6585th, Holloman AFB, N. Mexic) *In* Shock and Vibration Information Center The Shock and Vibration Bulletin. Part 2: Instrumentation, Shock Analysis and Shock Testing Jan. 1987 p 105-11 (For primary document see N88-17053 09-39)
Avail: NTIS HC A08/MF A01 CSCL 20K

The response of structural systems subjected to dynamic impact conditions has long been of concern to system designers. More designers are faced with the response problem as mechanical impact testing becomes a more prevalent method of simulating pyrotechnic shock. This paper discusses the development that led to a simple one-dimensional impact code for up to five colliding bodies. The results of the theoretical model were correlated with measured data taken on three and six percent scale models of a rocket sled system for impact duration, maximum acceleration during impact, and departing velocity. Author

N88-17061*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
MEASUREMENT, DATA ANALYSIS AND PREDICTION OF PYROTECHNIC SHOCK FROM PIN-PULLERS AND SEPARATION JOINTS
Maria J. Evans, Vernon H. Neubert (Pennsylvania State Univ., University Park.), and Laurence J. Bement *In* Shock and Vibration Information Center The Shock and Vibration Bulletin. Part 2: Instrumentation, Shock Analysis and Shock Testing Jan. 1987 p 121-13 (For primary document see N88-17053 09-39)
Avail: NTIS HC A08/MF A01 CSCL 20K

To evaluate the potential for spacecraft damage caused by activation of pyrotechnic mechanisms, pyrotechnic shock tests were conducted on three configurations: pin-pullers on an orthogonal double Hopkinson bar arrangement, pin-pullers on a mock-up of the HALOE (Halogen Occultation Experiment) structure, and a section of separation joint on a single Hopkinson bar. Strains and accelerations were measured. The strains were converted to output stresses, forces and moments. Acceleration shock response spectra are presented for both acceleration- and force-time signals. The devices were attached to the Hopkinson bars with adaptors, which are typical of attachments used in practice. In order to predict the effect of the adaptors, finite element models of the adaptor-bar combinations were analyzed and results are presented with regard to grid size, time interval, and frequency range required to predict the response to pulses of 10 and 100 microsecond duration. Author

N88-17062# Shock and Vibration Information Center (Defense), Washington, D. C.
THE SHOCK AND VIBRATION BULLETIN. PART 4: STRUCTURAL DYNAMICS AND MODAL TEST AND ANALYSIS Monthly Report
Jan. 1987 146 p Presented at the 57th Symposium on Shock and Vibration, New Orleans, La., 14-16 Oct. 1986
(AD-A186751; SVIC-Bull-57-Pt-4) Avail: NTIS HC A07/MF A01 CSCL 20K

Various topics related to shock and vibration are discussed. Qualification by analysis of Inertial Upper Stage plume deflectors, the analysis of reinforced concrete structures under the effects of localized detonations, reinforced concrete arches under blast and shock environments, reliability of structures with stiffness and strength degradation, frequency response functions of a nonlinear system, and system optimization in nonlinear random vibration are among the topics covered. For individual titles, see N88-17063 through N88-17075.

N88-17063# Boeing Aerospace Co., Seattle, Wash.
QUALIFICATION BY ANALYSIS OF IUS PLUME DEFLECTORS c20
R. F. Hain *In* Shock and Vibration Information Center The Shock and Vibration Bulletin. Part 4: Structural Dynamics and Modal Test and Analysis Jan. 1987 p 1-7 (For primary document see N88-17062 09-39)
Avail: NTIS HC A07/MF A01 CSCL 21H

The method for qualification of the Inertial Upper Stage plume deflectors by analysis is described. The qualification by analysis is based on a finite element model that is verified by comparison with test data from another configuration of the plume deflector. Author

N88-17064# Minnesota Univ., Minneapolis. Dept. of Civil and Mineral Engineering.
ANALYSIS OF REINFORCED CONCRETE STRUCTURES UNDER THE EFFECTS OF LOCALIZED DETONATIONS
Theodor Krauthammer *In* Shock and Vibration Information Center The Shock and Vibration Bulletin. Part 4: Structural Dynamics and Modal Test and Analysis Jan. 1987 p 9-18 (For primary document see N88-17062 09-39)
Avail: NTIS HC A07/MF A01 CSCL 20K

A modified analytical method is proposed for studying the analytical behavior of reinforced concrete structural elements under the effects of localized detonations. In this approach, the combined effects of flexure, shear, and axial forces are considered for the development of accurate resistance functions which represent the structural response. These functions are then introduced into single degree of freedom computations by which the dynamic response is assessed. The computational procedure employs explicit relationships between structural mechanisms for evaluating structural element behavior at any stage of existence. Based on

this approach, it is possible to study the contributions of longitudinal and transverse reinforcement, material properties, support and loading conditions, and to correlate these parameters with observed behavior. Author

N88-17065# Minnesota Univ., Minneapolis. Dept. of Civil and Mineral Engineering.
REINFORCED COCNRETE ARCHES UNDER BLAST AND SHOCK ENVIRONMENTS
Theodor Krauthammer *In* Shock and Vibration Information Center The Shock and Vibration Bulletin. Part 4: Structural Dynamics and Modal Test and Analysis Jan. 1987 p 19-27 Sponsored in part by DNA and AFWL (For primary document see N88-17062 09-39)
Avail: NTIS HC A07/MF A01 CSCL 20K

Experimental results that were obtained from laboratory and field tests of shallow buried reinforced concrete arches over a period of about thirty years were combined for the development of behavior models which accurately describe the response of these structures. A simple analytical approach was adopted and employed for the analysis of several cases for which adequate experimental data were available, and the analytical results were found to be reasonably accurate. The present approach is a preliminary step in the development of a comprehensive numerical procedure for the assessment of such structures. Author

N88-17066# TRW, Inc., Los Angeles, Calif. Ballistic Missiles Div.
DYNAMIC STRESS AT CRITICAL LOCATIONS OF A STRUCTURE AS A CRITERION FOR MATHEMATICAL MODEL MODIFICATION
Ching-U Ip, Charles A. Vickery, Jr., and David I. G. Jones (Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio.) *In* Shock and Vibration Information Center The Shock and Vibration Bulletin. Part 4: Structural Dynamics and Modal Test and Analysis Jan. 1987 p 29-46 (For primary document see N88-17062 09-39)
Avail: NTIS HC A07/MF A01 CSCL 20K

An investigation of analysis methods for predicting dynamic stresses at specific critical locations in a structure by the finite element method is described. The development and improvement of modal models using a novel random walk approach to correct for differences between analytical and experimental results are discussed. Author

N88-17067# RCA Astro-Electronics Div., Princeton, N. J.
OPTIMIZED STRUCTURE DESIGN USING REANALYSIS TECHNIQUES
F. H. Chu, T. E. Pollak, and J. C. Reuben *In* Shock and Vibration Information Center The Shock and Vibration Bulletin. Part 4: Structural Dynamics and Modal Test and Analysis Jan. 1987 p 47-50 (For primary document see N88-17062 09-39)
Avail: NTIS HC A07/MF A01 CSCL 20K

A new approach for optimization of large structures with frequency constraint is presented. The REANALYSIS technique is used to iteratively evaluate feasible directions for achieving optimal solutions. Software was developed to implement this technique with the general purpose finite element NASTRAN analyser. An example of a space truss is given to illustrate the time savings and accuracy of this approach. Author

N88-17068# New Mexico Univ., Albuquerque. Dept. of Mechanical Engineering.
RELIABILITY OF STRUCTURES WITH STIFFNESS AND STRENGTH DEGRADATION
Frederick D. Ju *In* Shock and Vibration Information Center The Shock and Vibration Bulletin. Part 4: Structural Dynamics and Modal Test and Analysis Jan. 1987 p 51-63 (For primary document see N88-17062 09-39)
(Grant AF AFOSR-0085A-85)
Avail: NTIS HC A07/MF A01 CSCL 20K

A theory is established that can be used to evaluate the reliability of a generic class of a nonlinear system, especially for structural systems that show stiffness and strength degradations. The response random process is modeled as a Markov chain in a random environment. The random characteristics of the nonlinearity of the structural system is represented by a random process, which is called the structural noise. The structural noise is evaluated only when the energy dissipation sequences are given. The intensity of the structural noise is deterministic if the structural system is linear. However, for highly nonlinear structural responses such as concrete structures subjected to large excitation, the intensity of the structural noise and its probability density function are evaluated for the independent case. The first passage probability and mean square response are also computed in the numerical examples. Author

N88-17069# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio. Flight Dynamics Lab.
A NEW LOOK AT THE USE OF LINEAR METHODS TO PREDICT AIRCRAFT DYNAMIC RESPONSE TO TAXI OVER BOMB DAMAGED AND REPAIRED AIRFIELDS **c05**
James J. Olsen *In* Shock and Vibration Information Center The Shock and Vibration Bulletin. Part 4: Structural Dynamics and Modal Test and Analysis Jan. 1987 p 65-82 (For primary document see N88-17062 09-39)
Avail: NTIS HC A07/MF A01 CSCL 01C

The dynamic response of an aircraft that taxies over two arbitrary disturbances, under the assumption that the aircraft can be represented as a linear, one degree-of-freedom system is discussed. That analysis produces the concept of the BUMP MULTIPLIER which explicitly and simply determines whether a second discrete disturbance will amplify or attenuate the response from the first disturbance. The BUMP MULTIPLIER also simplifies the understanding and presentation of the results. While the assumptions are very severe, the resulting formulas can be very useful in gaining physical insight, as guides to more elaborate nonlinear calculations, and in planning test programs. Author

N88-17070# Sandia National Labs., Albuquerque, N. Mex.
FREQUENCY RESPONSE FUNCTIONS OF A NONLINEAR SYSTEM
D. A. Dederman, Thomas L. Paez, Dan L. Gregory, and R. G. Coleman *In* Shock and Vibration Information Center The Shock and Vibration Bulletin. Part 4: Structural Dynamics and Modal Test and Analysis Jan. 1987 p 83-94 Previously announced as N87-14742 (For primary document see N88-17062 09-39)
(Contract DE-AC04-76DP-00789)
Avail: NTIS HC A07/MF A01 CSCL 20K

The objective of this investigation is to establish the effects of the frequency response function of a simple system caused by structural rattling. The study uses a Monte Carlo approach in conjunction with numerical response analysis and laboratory experiments to assess the characteristics of the system. It is shown that the presence of rattling components in a structural system tends to diminish additional frequency response throughout the remainder of the excitation bandwidth. DOE

N88-17071# Sandia National Labs., Albuquerque, N. Mex.
SYSTEM CHARACTERIZATION IN NONLINEAR RANDOM VIBRATION
Thomas L. Paez and Dan L. Gregory *In* Shock and Vibration Information Center The Shock and Vibration Bulletin. Part 4: Structural Dynamics and Modal Test and Analysis Jan. 1987 p 95-101 (For primary document see N88-17062 09-39)
(Contract DE-AC04-76DP-00789)
Avail: NTIS HC A07/MF A01 CSCL 20K

The present investigation proposes a model for nonlinear structure characterization, and demonstrates how the functions describing the model can be identified using a random vibration experiment. Further, it is shown that the model is sufficient to completely characterize the stationary random vibration response of a structure that has a harmonic frequency generating form of nonlinearity. An analytical example is presented to demonstrate the plausibility of the model. Author

N88-17072# Southampton Univ. (England). Inst. of Sound and vibration Research.
AN INTERACTIVE-GRAPHICS METHOD FOR DYNAMIC SYSTEM MODELLING, APPLYING CONSISTENCY RULES
M. D. C. Dyne *In* Shock and Vibration Information Center The Shock and Vibration Bulletin. Part 4: Structural Dynamics and Modal Test and Analysis Jan. 1987 p 103-105 Sponsored in part by Ministry of Defence, United Kingdom (For primary document see N88-17062 09-39)
Avail: NTIS HC A07/MF A01 CSCL 20K

Some reasons why digital simulation employing bond graph principles has received recent attention for the study of the dynamics of physical systems and reports are discussed. An alternative approach to model synthesis and validation is discussed. Author

N88-17073# Concordia Univ., Montreal (Quebec). Dept. of Mechanical Engineering.
DYNAMIC RESPONSE OF A GEARED TRAIN OF ROTORS SUBJECTED TO RANDOM SUPPORT EXCITATIONS c37
S. V. Neriya, R. B. Bhat, and T. S. Sankar *In* Shock and Vibration Information Center The Shock and Vibration Bulletin. Part 4: Structural Dynamics and Modal Test and Analysis Jan. 1987 p 107-119 (For primary document see N88-17062 09-39)
Avail: NTIS HC A07/MF A01 CSCL 13I

The response of a geared train of rotors subjected to random support excitations is investigated. Support excitations occur, for instance, on board moving vehicles. These excitations are, in general, random in nature, and the response can be obtained using a statistical analysis. Here, the geared train of rotors is modeled using finite elements and the coupling between torsion and flexure is considered. The geared rotor system is excited by a displacement type of support excitation which is the output of a filter, the input to which is a Gaussian stationary process with a white noise type of power spectral density. The excitation is assumed to be in the vertical direction only, and the excitations through the supports are assumed to be uncorrelated. Results for the response power spectral densities are presented for two kinds of filters. Author

N88-17074*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
THE DYNAMICS OF AN OSCILLATING FOUR-BAR LINKAGE
Ping Tcheng *In* Shock and Vibration Information Center The Shock and Vibration Bulletin. Part 4: Structural Dynamics and Modal Test and Analysis Jan. 1987 p 121-131 (For primary document see N88-17062 09-39)
Avail: NTIS HC A07/MF A01 CSCL 20K

The design, analysis and application of a unique oscillating double four-bar linkage is described. The Lagrange equation for the slightly damped second-order system was derived and verified experimentally. System natural frequencies ranging from one to thirty Hertz with a damping coefficient less than 0.001 were observed. Special dynamic characteristics of this linkage and results of a shake test are presented. Various instrumentation applications of this simple but rugged mechanism are included. Author

N88-17075*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
CENTAUR G PRIME MODAL TEST
Marc Trubert, Art Cutler, Robert Miller, Don Page, and Charles Engelhardt (Structural Dynamics Research Corp., San Diego, Calif.) *In* Shock and Vibration Information Center The Shock and Vibration Bulletin. Part 4: Structural Dynamics and Modal Test and Analysis Jan. 1987 p 133-144 (For primary document see N88-17062 09-39)
Avail: NTIS HC A07/MF A01 CSCL 20K

The Centaur G Prime modal test resulted in sets of modes (frequencies, mode shapes and damping) with an accuracy similiar to or better than that normally obtained from the modal testing of linear structures with no backlash and small damping. In other words, performing the test at high level greatly minimized the backlash effect and provided a valid, simple linearization of the trunnion friction problem for the Centaur in the Shuttle Cargo Bay. All the most important modes (target modes) were measured and provided the data base for updating the finite element model for the pre-flight verification loads analysis. Author

N88-17076# Technische Univ., Aachen (West Germany). Fakultaet fuer Maschinenwesen.
INVESTIGATIONS OF THE EQUILIBRIUM AND STABILITY OF THIN-WALLED DOUBLE RINGS. A CONTRIBUTION TO THE SOLUTION OF SINGLE-SIDED CONTACT PROBLEMS Ph.D. Thesis [UNTERSUCHUNGEN UEBER DAS GLEICHGEWICHT UND DIE STABILITAET DUENNWANDIGER DOPPELRINGE. EIN BEITRAG ZUR LOESUNG EINSEITIGER KONTAKTPROBLEME]
Walter Huessler 1984 185 p In GERMAN
(ETN-87-90044) Avail: NTIS HC A09/MF A01

Equilibrium and stability problems of thin-walled double rings were analyzed as contact problems. The stability was treated according to specifications such as the compression buckling of cylinders under hydrostatic outer pressure. It is found that the inner rings or tubes can become unstable. The load-bearing capacity depends on the amplitude of a perturbation which is always present in real structures between inner and outer wall. The critical load for real perturbations is almost always determined by the elasticity limit or the breaking point, and is within the stable equilibrium domain. For loadings of plastic materials, the critical load can be determined taking into account a plastic joint, and can be compared with the loading obtained by a Cozzone stress analysis; in this calculation a nonlinear stress distribution in the cross section is considered. Author (ESA)

N88-17077# Bristol Univ. (England). Dept. of Mechanical Engineering.
THE FAILURE AND FRACTURE ANALYSIS OF ADHESIVE BONDS Ph.D. Thesis
Zhiwei Chen Apr. 1985 248 p Sponsored by Chinese Ministry of Education, People's Republic of China and the British Council, United Kingdom
(ETN-87-90713) Avail: NTIS HC A11/MF A01

The finite element method was used to examine the stress and strain distribution in adhesive bonds and to assess failure criteria. Tension, torsion, and fracture loading tests were performed on two bulk adhesive materials. Lap joints made from different adherend materials were also tested. Results show that the strength of real joints can be predicted from the basic mechanical properties of the individual materials, provided the right failure criterion is used. Yield and failure stress of an adhesive are not important, while the failure strain energy and fracture toughness are. Shrinkage residual stresses are important, especially for brittle adhesives. Spew fillets are helpful for strengthening lap joints. Author (ESA)

N88-17078*# Lockheed Aircraft Corp., Palo Alto, Calif. Research Lab.
CONSISTENT LINEARIZATION OF THE ELEMENT-INDEPENDENT COROTATIONAL FORMULATION FOR THE STRUCTURAL ANALYSIS OF GENERAL SHELLS Final Report
C. C. Rankin Jan. 1988 54 p
(Contract NAS1-18101)
(NASA-CR-178418; NAS 1.26:178418) Avail: NTIS HC A04/MF A01 CSCL 20K

A consistent linearization is provided for the element-dependent corotational formulation, providing the proper first and second variation of the strain energy. As a result, the warping problem that has plagued flat elements has been overcome, with beneficial effects carried over to linear solutions. True Newton quadratic convergence has been restored to the Structural Analysis of General Shells (STAGS) code for conservative loading using the full corotational implementation. Some implications for general finite element analysis are discussed, including what effect the automatic frame invariance provided by this work might have on the development of new, improved elements. Author

N88-17079# Admiralty Research Establishment, Dunfermline (England).
FABSTRAN: A COMPUTER PROGRAM FOR FRAME AND BEAM STATIC AND TRANSIENT RESPONSE ANALYSIS (NONLINEAR)
R. S. Dow and C. S. Smith Dec. 1986 74 p
(ARE-TR-86205; BR101681; ETN-88-91513) Copyright Avail: NTIS HC A04/MF A01

An analysis method and computer program for evaluation of the large-displacement, elastoplastic behavior of plane frames and beam-columns under static or transient dynamic loads are described. The program may be used to evaluate inelastic bending and buckling behavior of stiffened panels under lateral loads (including air blast) and in-plane compression, collapse of long, externally pressurized ring-stiffened cylinders including imperfection and damage effects, and collapse of tubular beam-columns including the influence of local denting damage. Guidance on use of the program is provided and examples of its application are given. ESA

N88-17080# British Aerospace Public Ltd. Co., Preston (England). Structural Test Dept.
TO DETERMINE THE STRESS DISTRIBUTION IN THE VICINITY OF GRP END PADS WHERE THE SPECIMEN IS HELD AND LOADED (CFC COUPON SPECIMENS)
D. A. Ward Jun. 1987 12 p
(BAe-WST-R-RES-CFC-12023; RFT-824/BT/62; ETN-88-91515) Copyright Avail: NTIS HC A03/MF A01

Stress distribution near CFC specimen loading pads and loading/unloading characteristics from a point where audible cracking of the specimen first occurs were investigated. On neither of the two loading runs, run 1 to 42 kN and run 2 to catastrophic failure at 56 kN, were any audible noises detected, thus rendering impossible the secondary stated objectives. The stress distribution results obtained should assist in the understanding of the load distribution associated with GRP end pads bonded to CFC coupon specimens, and can be used to establish the difference in the transverse strains at the edge and in the middle of the specimen. ESA

N88-17081# British Aerospace Public Ltd. Co., Preston (England). Structural Test Dept.
FURTHER TESTS TO DETERMINE THE STRESS DISTRIBUTION IN THE VICINITY OF GRP END PADS WHERE THE SPECIMEN IS HELD AND LOADED (CFC COUPON SPECIMENS)
D. A. Ward Jun. 1987 14 p
(BAe-WST-R-RES-CFC-12023-Add-1; RFT-824/BT/62; ETN-88-91516) Copyright Avail: NTIS HC A03/MF A01

Stress distribution near CFC specimen loading pads and loading/unloading characteristics from a point where audible cracking of the specimen first occurs were investigated. On the first specimen tested, no audible noises were detected. The second specimen was tested without GRP end pads so a direct comparison of the stress distributions could be made for specimens with and without GRP end pads. Again on this specimen no audible noises were detected until catastrophic failure at 59.1 kN. The tests allow a direct comparison of strains to be undertaken in basically identical specimens, with and without GRP end pads, and should assist in the understanding of the load distribution associated with load introduction on coupon tests. ESA

N88-17082# Technische Hogeschool, Delft (Netherlands).
OPTICAL ANALYSIS OF STRESS AND STRAIN IN PHOTOELASTIC PARTICLE ASSEMBLIES Ph.D. Thesis
Henderikus G. B. Allersma 1987 176 p
(ETN-88-91591) Avail: NTIS HC A09/MF A01

Optical methods for determining stresses and strains in assemblies of photoelastic granular material, and a device for performing systematic measurements in scale models of practical problems and material testing devices were developed. A method for determining two stress components in a three-dimensional plane strain sample; a calculation procedure for determining absolute stresses; and a prototype of a device for performing the measurements are described. A computer-controlled optical device equipped with a digital camera was produced. Stresses and displacements can be measured simultaneously. The measuring method was successfully applied to analyzing the mechanical behavior of granular materials in several tests, which simulate practical problems and material testing devices. ESA

N88-17083# Technical Research Centre of Finland, Espoo. Metals Lab.
DEVELOPMENT AND CALIBRATION OF DIRECT CURRENT POTENTIAL DIFFERENCE (DCPD) CRACK LENGTH MEASUREMENT EQUIPMENT
Henrik Sundell May 1987 39 p
(Contract KTM-MET70215)
(VTT-RR-480; ISBN-951-38-2879-4; ISSN-0358-5077; ETN-88-91662) Copyright Avail: NTIS HC A03/MF A01

The applicability of a switching dc potential difference (DCPD) method to crack length estimations in ferromagnetic materials was investigated using stainless steel (AISI 316) pipes (diameter 10 mm) and compact tension specimens of different steel compositions. In creep crack measurements and with slow loading rates the direct current method is suitable. The crack extension can be calculated from the potential readings and the crack extension is in good agreement (error less than 10 percent) with optical measurements and 2 dimensional metal film measurements. The DCPD results seem to be better than the results from the unloading compliance method. The DCPD equipment developed is very stable and is suitable for long term creep crack tests. The DCPD method is not suitable for rapid loading rates. The presence of stress in high current density fields induces magnetoelastic effects which overwhelm the dc potential changes during high loading rates with magnetic structural materials. ESA

N88-17084# Aeronautical Research Inst. of Sweden, Stockholm. Aerodynamics Dept.
SELF-ADAPTIVE ANALYSIS OF THREE-DIMENSIONAL STRUCTURES USING A p-VERSION OF FINITE ELEMENT METHOD
Boerje Andersson and Urban Falk Aug. 1987 47 p Presented at the First World Congress on Computational Mechanics, Austin, Tex., 22-26 Sep. 1986 Sponsored by the Swedish Material (Material Dept.) Air Administration of Armed Forces
(FFA-TN-1987-31; ETN-88-91666) Avail: NTIS HC A03/MF A01

The self-adaptive finite element program STRIPE for solution of problems in three-dimensional elastomechanics is described. It uses a p-version of the finite element method where each finite element automatically is assigned an order of approximation pi for the xi-displacements to obtain the lowest error in the energy norm given the number of degrees of freedom. A simple energy error estimator used to terminate the adaptive process is outlined. A method for calculating the mode 1, 2, and 3 stress intensity factors in solids of isotropic materials was developed. The high accuracy obtained using this method is demonstrated. The rates of convergence to expect from the p-version of the finite element method when solving three-dimensional problems are illustrated. The computational efficiency of the p-version of the finite element method for solving real-life problems is demonstrated by analyzing a complex main frame fuselage of fighter aircraft. ESA

N88-17085 Technische Hochschule, Darmstadt (West Germany). Fachgebiet Werkstoffmechanik.
EXPERIMENTAL DETERMINATION OF CRACK GROWTH RATES IN CYCLIC STRESS APPLICATIONS, FOR IMPROVING THE FORECASTED COMPUTED DURABILITY IN OPERATION [EXPERIMENTELLE BESTIMMUNG DES SCHWELLWERTES FUER RISSWACHTUM UNTER ZYKLISCHER BEANSPRUCHUNG ZUR VERBESSERUNG DER RECHNERISCHEN LEBENSDAUERVORHERSAGE BEI BETRIEBSBELASTUNG]
K. Windte 1986 60 p In GERMAN
(FF-14/1986; ETN-88-90785) Copyright Avail: Issuing Activity

A fine-grained steel (StE 460) and an aluminum alloy AlMg 4.5 Mn were studied. Three methods were used for testing the crack growth rates: (1) Doker, Bachmann and Marci; (2) the method recommended by the ASTM; and (3) the Suresh-method were an initial crack is made in the sample. It is difficult to compare the results as only one test was performed per method and per material. The figures of (1) and (3) correspond relatively well; those of (2) are different, especially for steel. Tests (1) and (3) lasted for 1 week and (2) for 2 or 3 weeks. It seems that method (1) is easier to perform. ESA

N88-17086 GKSS-Forschungszentrum Geesthacht (West Germany). Inst. fuer Anlagentechnik.
FINITE ELEMENT ANALYSIS FOR THE CALCULATION OF CALIBRATION CURVES OF FRACTURE MECHANICS SPECIMEN FOR SEMICIRCULAR SURFACE CRACKS WITH SEVERAL STARTING DEPTHS, FOR THE CRACK DEPTH MEASUREMENT FOLLOWING THE dc POTENTIAL METHOD [FINITE-ELEMENT-ANALYSE ZUR EICHKURVENBERECHNUNG VON BRUCHMECHANIKPROBEN BEI HALBKREISFOERMIGEN OBERFLAECHENRISSEN VERSCHIEDENER ANRISSTIEFE FUER DIE RISSTIEFENMESSUNG NACH DER GLEICHSTROM-POTENTIAL-METHODE]
R. Dietrich and W. Schoenfeld 1 Mar. 1987 21 p In GERMAN; ENGLISH summary
(GKSS-87/E/19; ISSN-0344-9629; ETN-88-91049) Copyright Avail: Issuing Activity

The finite element method was used for the calculation of the calibration curves, required for the electrical dc potential crack monitoring systems applied to fracture mechanics specimens with thicknesses (B) between 5 and 20mm, and a starting crack depth of 0.1 B. The measured calibration curves for different values of B are discussed. It is shown that the effect of the specimen thickness is smaller than that of the initial crack depth. ESA

N88-17087# Fraunhofer Inst. fuer Werkstoffmechanik, Freiburg (West Germany).
FRACTURE MECHANICS CHARACTERIZATION OF CRACK GROWTH UNDER CREEP AND FATIGUE CONDITIONS European Concerted Action. Cost 501. Final Report
Thomas Hollstein and Reinhold Kienzler Feb. 1987 89 p
(Contracts BMFT-03-ZYK-0421/D10; FhG-Proj-301-140)
(W-2/87; ETN-88-91461) Avail: NTIS HC A05/MF A01

Concepts to correlate crack growth under high temperature conditions with material parameters of fracture mechanics, e.g., stress intensity factor and line integrals J and C* were investigated. It is shown for different materials that these parameters describe the behavior of cracks independent of geometry and loading conditions within certain limits of validity. The laboratory results then can be transferred to real structures for (residual) lifetime predictions or safety analyses. Numerical simulations of experiments and, in particular, of structural parts are essential for the understanding of crack-tip deformation behavior. Theoretical and numerical tools can be used to derive approximate and simple formulas which can be used to calculate loading parameters. ESA

N88-17088# Royal Aircraft Establishment, Farnborough (England).
BOUNDARY ELEMENTS COMBINED WITH SINGULAR FIELDS FOR THREE-DIMENSIONAL CRACKED SOLIDS
D. P. Rooke, D. J. Cartwright, and M. H. Aliabadi (Southampton Univ., England) Jun. 1987 21 p Presented at the 4th International Conference on Numerical Methods in Fracture Mechanics, San Antonio, Tex., 22-26 Mar. 1987 Previously announced in IAA as A88-16928
(RAE-TR-87038; RAE-199(MAT/STR); BR103338; ETN-88-91534) Copyright Avail: NTIS HC A03/MF A01

The boundary element method is used to obtain weight functions for three-dimensional solids containing cracks. A singular displacement field analogous to the two-dimensional Bueckner field is derived for a planar rectilinear crack subjected to equal and opposite localized forces on the crack surface. This field is prescribed around a small cylindrical cavity along the crack front and the boundary element method is used to obtain weight functions for the stress intensity factor. The advantages of the method are demonstrated for an edge cracked rectangular bar. ESA

N88-17089# Technical Research Centre of Finland, Espoo. Metals Lab.
STRENGTH AND TOUGHNESS OF A BRITTLE MATERIAL
Pertti Auerkari, Juha Kumpulainen, and Kim Wallin May 1987 23 p In FINNISH; ENGLISH summary
(VTT-RR-479; ISBN-951-38-2870-0; ISSN-0358-5077; ETN-88-91661) Copyright Avail: NTIS HC A03/MF A01; Technical Research Centre of Finland, Espoo, Finland FIM 40

The strength and toughness of brittle materials are studied using a statistical approach to treat the scatter of test results. Structural performance tests result variance is due to a combination of the effects of material properties, defects, and deviations from the expected loading geometry. The two latter components are found to be very significant in the case of brittle materials. For this reason conventional tensile testing is not recommended for brittle materials. The linear elastic fracture toughness method is usually adequate to test toughness of most brittle materials, but other methods may be needed in the case of materials with large toughness characteristics extending beyond the linear elastic regime. ESA

N88-17090*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
ACCURACIES OF SOUTHWELL AND FORCE/STIFFNESS METHODS IN THE PREDICTION OF BUCKLING STRENGTH OF HYPERSONIC AIRCRAFT WING TUBULAR PANELS
William L. Ko Nov. 1987 28 p
(NASA-TM-88295; H-1415; NAS 1.15:88295) Avail: NTIS HC A03/MF A01 CSCL 20K

Accuracies of the Southwell method and the force/stiffness (F/S) method are examined when the methods were used in the prediction of buckling loads of hypersonic aircraft wing tubular panels, based on nondestructive buckling test data. Various factors affecting the accuracies of the two methods were discussed. Effects of load cutoff point in the nondestructive buckling tests on the accuracies of the two methods were discussed in great detail. For the tubular panels under pure compression, the F/S method was found to give more accurate buckling load predictions than the Southwell method, which excessively overpredicts the buckling load. It was found that the Southwell method required a higher load cutoff point, as compared with the F/S method. In using the F/S method for predicting the buckling load of tubular panels under pure compression, the load cutoff point of approximately 50 percent of the critical load could give reasonably accurate predictions. Author

N88-17091# Argonne National Lab., Ill.
FOCUSED ULTRASONIC BACKSCATTER TECHNIQUE FOR NEAR-SURFACE FLAW DETECTION IN STRUCTURAL CERAMICS
R. A. Roberts Jun. 1987 13 p Presented at the 16th Symposium on Nondestructive Evaluation, San Antonio, Tex., 21 Apr. 1987
(Contract W-31-109-eng-38)
(DE88-003112; CONF-8704231-3) Avail: NTIS HC A03/MF A01

This paper describes a focused ultrasonic backscatter technique that is currently being used at Argonne for the detection of near-surface flaws in ceramic Modulus-Of-Rupture (MOR) bars. The technique exploits the generation of leaky surface waves in such a way that precise transducer positioning is not critical; for this reason, it is a potential candidate for the inspection of curved surfaces. Included in the presentation of results are the detection of near-surface flaws in Si sub 3 N sub 4 MOR bars, and a correlation of nondestructive evaluation and fractography results after failure in four-point bending. DOE

N88-17092# Los Alamos National Lab., N. Mex.
EXPERIENCE OF DEVELOPING AN INTEGRATED NONDESTRUCTIVE ASSAY SYSTEM
S. T. Hsue and M. P. Baker 1987 7 p Presented at the 3rd International Conference on Facility Operations Safeguards Interface, San Diego, Calif., 29 Nov. 1987
(Contract W-7405-eng-36)
(DE88-003149; LA-UR-87-3966; CONF-871110-7) Avail: NTIS HC A02

A consortium of national laboratories is collaborating with the Savannah River Plant to develop an integrated system of state-of-the-art nondestructive assay (NDA) instrumentation to provide nuclear materials accounting and process control information for a new plutonium scrap recovery facility. Individual microcomputer-based instruments report assay results to an instrument control computer (ICC). The ICC, in turn, is part of a larger computer network including computers which perform process control and nuclear materials accounting functions. The experience in developing the integrated NDA system, the design, and the testing are discussed. DOE

N88-17093# Oak Ridge Y-12 Plant, Tenn.
DETECTION OF HYDROGEN-ASSISTED-CRACKING IN U-0.8TI ALLOY WELDMENTS BY ACOUSTIC EMISSION MONITORING
J. W. Whittaker and M. W. Richey 3 Nov. 1987 16 p Presented at the 7th Interagency Acoustic Emission Conference, Golden, Colo., 31 Mar. 1987
(Contract DE-AC05-84OS-21400)
(DE88-003221; Y/DW-716; CONF-8703210-1) Avail: NTIS HC A03/MF A01

Electron-beam weldments of U-0.8Ti alloys have demonstrated a sensitivity to hydrogen-assisted-cracking (HAC). A survey experiment was undertaken to determine if RH threshold value exists for HAC formation. Since long periods are often required for crack formation, a method was needed to determine when a crack(s) formed. Acoustic emissions monitoring was selected because of its sensitivity and adaptability to long-term monitoring. DOE

N88-17094# Sandia National Labs., Albuquerque, N. Mex.
EXPERIMENTAL IDENTIFICATION OF NONLINEAR STRUCTURAL MODELS
T. L. Paez and N. F. Hunter 1988 24 p Presented at the 6th International Modal Analysis Conference, Orlando, Fla., 1 Feb. 1988 Prepared in cooperation with Los Alamos National Lab., N. Mex.
(Contract W-7405-eng-36)
(DE88-001795; LA-UR-87-3582; CONF-880220-2) Avail: NTIS HC A03/MF A01

A fundamental objective of structural dynamic engineering is to understand the behavior of physical structures subjected to field environments. In practical situations, many structures execute nonlinear motions, and under the influence of extreme excitations structures often show strongly nonlinear responses. Recent investigations have shown that the Volterra model provides a means for system characterization that holds great potential for the description of nonlinear structural response. Simulations have shown that when the Volterra model of a structure is available, it can provide a reasonable match to numerically simulated nonlinear response. The present investigation considers the identification of the functions used in the Volterra model for physical structures tested in the laboratory. It is shown that the frequency form of the Volterra functions can be estimated directly using measured excitation and response data. A coherence-like measure of the observed structural response and the nonlinear model is developed, and it is shown that this quantity can be used to evaluate the accuracy of the nonlinear structural model. Finally, the characteristics of structures most suitably modelled by the Volterra series are discussed. DOE

N88-17095*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
STRESS INTENSITY AND CRACK DISPLACEMENT FOR SMALL EDGE CRACKS
Thomas W. Orange Feb. 1988 11 p
(NASA-TP-2801; E-3744; NAS 1.60:2801) Avail: NTIS HC A03/MF A01 CSCL 20K

The weight function method was used to derive stress intensity factors and crack mouth displacement coefficients for small edge cracks (less than 20 percent of the specimen width) in common fracture specimen configurations. Contact stresses due to point application of loads were found to be small but significant for three-point bending and insignificant for four-point bending. The results are compared with available equations and numerical solutions from the literature and with unpublished boundary collocation results. Author

N88-16633*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
REVIEW OF FATIGUE AND FRACTURE RESEARCH AT NASA LANGLEY RESEARCH CENTER
Richard A. Everett, Jr. *In* NASA, Washington, NASA/Army Rotorcraft Technology. Volume 2: Materials and Structures, Propulsion and Drive Systems, Flight Dynamics and Control, and Acoustics Feb. 1988 p 535-572 (For primary document see N88-16632 09-01)
Avail: NTIS HC A25/MF A01 CSCL 20K

N88-16701*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
CREEP AND FATIGUE RESEARCH EFFORTS ON ADVANCED MATERIALS
John Gayda *In its* Aeropropulsion '87. Session 1: Aeropropulsion Materials Research Nov. 1987 18 p (For primary document see N88-16697 09-07)
Avail: NTIS HC A06/MF A01 CSCL 20K

42 GEOSCIENCES (GENERAL)

N88-17096*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
NIMBUS 7 SOLAR BACKSCATTER ULTRAVIOLET (SBUV) SPECTRAL SCAN SOLAR IRRADIANCE AND EARTH RADIANCE PRODUCT USER'S GUIDE
Barry M. Schlesinger, Richard P. Cebula (ST Systems Corp., Hyattsville, Md.), Donald F. Heath, and Albert J. Fleig Feb. 1988 65 p
(Contract NAS5-29386)
(NASA-RP-1199; NAS 1.61:1199; Rept-88-0004) Avail: NTIS HC A04/MF A01 CSCL 04A

The archived tape products from the spectral scan mode measurements of solar irradiance (SUNC tapes) and Earth radiance (EARTH tapes) by the Solar Backscatter UV (SBUV) instrument aboard Nimbus 7 are described. Incoming radiation from 160 to 400 nm is measured at intervals of 0.2 nm. The scan-to-scan repeatability of the solar irradiance measurements ranges from approximately 0.5 to 1 percent longward of 280 nm, to 2 percent around 210 nm and 4 percent near 175 nm. The repeatability of the Earth radiance values ranges from 2 to 3 percent at longer wavelengths and low zenith angles to 10 percent at shorter wavelengths and high zenith angles. The tape formats are described in detail, including file structure and contents of each type of record. Catalogs of the tapes and the time period covered are provided, along with lists of the days lacking solar irradiance measurements and the days dedicated to Earth radiance measurements. The method for production of the tapes is outlined and quality control measures are described. How radiances and irradiances are derived from the raw counts, the corrections for changes in instrument sensitivity, and related uncertainties are discussed. Author

43 EARTH RESOURCES AND REMOTE SENSING

Includes remote sensing of earth resources by aircraft and spacecraft; photogrammetry; and aerial photography.

For instrumentation see *35 Instrumentation and Photography.*

N88-17097*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
GLOBAL DIGITAL DATA SETS OF SOIL TYPE, SOIL TEXTURE, SURFACE SLOPE AND OTHER PROPERTIES: DOCUMENTATION OF ARCHIVED DATA TAPE
B. Staub, C. Rosenzweig, and D. Rind Oct. 1987 20 p
(NASA-TM-100685; NAS 1.15:100685) Avail: NTIS HC A03/MF A01 CSCL 08M

The file structure and coding of four soils data sets derived from the Zobler (1986) world soil file is described. The data were digitized on a one-degree square grid. They are suitable for large-area studies such as climate research with general circulation models, as well as in forestry, agriculture, soils, and hydrology. The first file is a data set of codes for soil unit, land-ice, or water, for all the one-degree square cells on Earth. The second file is a data set of codes for texture, land-ice, or water, for the same soil units. The third file is a data set of codes for slope, land-ice, or water for the same units. The fourth file is the SOILWRLD data set, containing information on soil properties of land cells of both Matthews' and Food and Agriculture Organization (FAO) sources. The fourth file reconciles land-classification differences between the two and has missing data filled in. J.P.B.

N88-17098# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Freiburg (West Germany).
INVESTIGATIONS ON THE APPLICATION OF SPACE PHOTOGRAPHS (SPACELAB METRIC CAMERA) FOR ROUTINE INVENTORIES OF EXTENSIVELY MANAGED FOREST AREAS
Thesis - Freiburg Univ., Fed. Republic of Germany
Wolf Forstreuter Dec. 1986 252 p In GERMAN; ENGLISH summary Original contains color illustrations
(DFVLR-FB-87-22; ISSN-0171-1342; ETN-88-91447) Avail: NTIS HC A12/MF A01; DFVLR, Cologne, Fed. Republic of Germany DM 135

The applicability of photos for forest inventories was investigated. The pictures were taken with a metric camera in space, and are comparable with LANDSAT data in many respects. The characteristics of the Spacelab pictures and their information content with respect to large-area inventories are discussed. The results demonstrate the applicability for forest inventories. The different data processing possibilities, and the availability of the data are discussed. ESA

N88-17099# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany). Abteilung Meteorologische Fernerkundung.
STATISTICS OF TWO-DIMENSIONAL STRUCTURE ELEMENTS OF MOUNTAINOUS RANGES (MOSAIC MODEL) FOR CALCULATING THREE-DIMENSIONAL REFLECTION FUNCTIONS
Ruediger H. Buell Sep. 1987 66 p In GERMAN; ENGLISH summary
(DFVLR-FB-87-33; ISSN-0171-1342; ETN-88-91693) Avail: NTIS HC A04/MF A01; DFVLR, Cologne, Federal Republic of Germany, DM 23.50

Three-dimensional reflection functions were calculated in order to determine the albedo of an orographically partitioned terrain from satellite data. Quantities such as valley statistics and synthetic valley cross sections were determined by the analysis of two-dimensional structure elements of the terrain. These quantities allow the calculation of three-dimensional reflection functions. The methods of the computer program system for such an analysis are described. The application of the program system to two regions of the Alps yields acceptable results. ESA

N88-17100# European Space Agency, Paris (France).
FUNDAMENTAL ASPECTS OF THE PHYSICS OF REMOTE SENSING
Alois J. Sieber Sep. 1987 214 p Transl. into ENGLISH of Physikalische Grundlagen der Fernerkundung (DFVLR, Oberpfaffenhofen, Fed. Republic of Germany), 1986 Original language document was announced as N87-18228
(ESA-TT-1045; DFVLR-FB-86-37; ETN-88-91712) Avail: NTIS HC A10/MF A01; original German version available from DFVLR, Cologne, Fed. Republic of Germany DM 54

The physical background of remote sensing methods, based on the electromagnetic interaction are discussed. Remote sensing and signature are defined. Optical remote sensing, and active and passive microwave remote sensing are analyzed. Examples of measurements and images are used to elucidate the basic physical principles. ESA

N88-17101# Physics and Electronics Lab. TNO, The Hague (Netherlands). Divisie 1: Operationele Research.
DESIGN AND IMPLEMENTATION OF A DATA BASE SYSTEM FOR DIGITAL LAND MASS SYSTEM (DLMS) DATA
J. C. Bron, J. Kievit, and M. R. Schurink May 1987 54 p In DUTCH; ENGLISH summary Original contains color illustrations
(FEL-IR-1987-19; ETN-88-91563) Avail: NTIS HC A04/MF A01

Highly detailed and multipurpose digital terrain data was produced for a large part of Europe. These so-called Digital Land Mass System (DLMS) data are delivered on raw-format tapes. The design, implementation, and use of a data base system to transform DLMS-data to structured files, needed for specific applications are described. ESA

N88-17102# National Academy of Sciences - National Research Council, Washington, D. C. Polar Research Board.
RECOMMENDATIONS FOR A US ICE CORING PROGRAM
1986 79 p
(PB88-115043) Avail: NTIS HC A05/MF A01 CSCL 08L

The current status of ice core research in the United States is examined and specific steps recommended to implement an ice coring and analysis program. Successful execution of such a program requires a number of elements, which must be individually successful and interact with one another with positive feedback loops. The elements may be divided into two groups. The first concerns management action to mobilize a talented personnel base and to create a mode of operation allowing personnel to focus their energies productively. The second concerns scientific and technical requirements. The report addresses both of these groups, but gives special attention to the first. GRA

N88-17103*# Utah Univ., Salt Lake City. Center for Remote Sensing and Cartography.
DETECTION OF SOIL EROSION WITH THEMATIC MAPPER (TM) SATELLITE DATA WITHIN PINYON-JUNIPER WOODLANDS
Kevin Paul Price Dec. 1987 210 p Sponsored in part by USDA Soil Conservation Service
(Grant NAGw-95)
(NASA-CR-182476; NAS 1.26:182476; CRSC-87-2) Avail: NTIS HC A10/MF A01 CSCL 02F

Pinyon-Juniper woodlands dominate approximately 24.3 million hectares (60 million acres) in the western United States. The overall objective was to test the sensitivity of the LANDSAT Thematic Mapper (TM) spectral data for detecting varying degrees of soil erosion within the Pinyon-Juniper woodlands. A second objective was to assess the potential of the spectral data for assigning the Universal Soil Loss Equation (USLE) crop management (C) factor values to varying cover types within the woodland. Thematic Mapper digital data for June 2, 1984 on channels 2, 3, 4, and 5 were used. Digital data analysis was performed using the ELAS software package. Best results were achieved using CLUS, an unsupervised clustering algorithm. Fifteen of the 40 Pinyon-Juniper signatures were identified as being relatively pure Pinyon-Juniper woodland. Final analysis resulted in the grouping of the 15 signatures into three major groups. Ten study sites were selected

from each of the three groups and located on the ground. At each site the following field measurements were taken: percent tree canopy and percent understory cover, soil texture, total soil loss, and soil erosion rate estimates. A technique for measuring soil erosion within Pinyon-Juniper woodlands was developed. A theoretical model of site degradation after Pinyon-Juniper invasion is presented. Author

N88-16761# European Space Agency. ESRIN, Frascati (Italy). Earthnet Program Office.
THE EARTHNET HEAT CAPACITY MAPPING MISSION (HCMM) DATA-PROCESSING SYSTEM AT LANNION (FRANCE)
L. Fusco *In its* ESA Bulletin No. 24 Nov. 1980 p 46-52
(For primary document see N88-16755 09-12)
Copyright Avail: NTIS HC A05/MF A01

44 ENERGY PRODUCTION AND CONVERSION

Includes specific energy conversion systems, e.g., fuel cells; global sources of energy; geophysical conversion; and windpower.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *28 Propellants and Fuels.*

N88-17104# GA Technologies, Inc., San Diego, Calif.
VARIABLE BAND GAP MATERIALS FOR THERMOPHOTOVOLTAIC GENERATORS Final Technical Report, 1 Apr. 1986 - 31 Aug. 1987
Lawrence D. Woolf, Dennis M. Duggan, and Joe N. Smith, Jr. Aug. 1987 66 p
(Contract F49620-86-C-0043)
(AD-A186858; GA-A18953; AFOSR-87-1537TR) Avail: NTIS HC A04/MF A01 CSCL 10B

The objective of this research program was to design and develop direct band gap solar cells which would have high below band gap energy (infrared - IR) reflectivity for use in high efficiency thermophotovoltaic (TPV) energy conversion systems. Two types of customized GaAs cells were grown on intrinsic or semi-insulating GaAs substrates with either p-type GaAs or Al(.9) Ga(.1)As stop-etch layers. Holes were drilled through the substrate using a laser photochemical etch technique. Cells with high IR reflectivity and low series resistance were fabricated by drilling a hole which stopped at the contact layer of the cell with the Al(.9) Ga(.1) As stop-etch layer and then depositing gold in the hole and on the back surface. Measurements of these customized cells indicate that IR reflectivities in excess of 90 percent, corresponding to TPV efficiencies in excess of 35 percent, are feasible. GRA

N88-17105# Naval Postgraduate School, Monterey, Calif.
FORWARD-BIASED CURRENT ANNEALING OF RADIATION DAMAGED GALLIUM ARSENIDE AND SILICON SOLAR CELLS M.S. Thesis
Richard L. Staats Sep. 1987 101 p
(AD-A186904) Avail: NTIS HC A06/MF A01 CSCL 10B

Radiation damaged gallium arsenide and silicon solar cells were annealed using a combination of thermal and Forward-bias Current Annealing techniques. These cells were annealed under varying current densities from 0.125 A/sq cm to 1.250 A/sq cm and at temperatures from 90 C to 140 C. Gallium arsenide solar cells annealed at current densities from 0.250 A/sq cm to 0.750 A/sq cm. Attempts to anneal silicon solar cells failed to produce positive results at all current densities. The primary application of this research is to determine the feasibility of on-orbit annealing of a satellite's solar array. At present, only silicon solar cells are deployed in space to provide electric power for satellites. When GaAs solar cells become space qualified, on-orbit Forward-bias Current Annealing of these solar arrays may significantly increase the end of life of orbiting satellites. GRA

N88-17106# British Aerospace Dynamics Group, Bristol (England). Space and Communications Div.
STUDY OF LARGE SOLAR ARRAYS (SOLA), PHASE 2A Final Report
J. Pope, comp., C. P. Lee, R. K. Bradford, E. Winter, H. Bebermeier, G. Behrens, W. Schmitt, and H. Akister (Royal Netherlands Aircraft Factories Fokker, Schiphol-Oost.) Paris, France ESA Jul. 1983 54 p
(Contract ESA-4903/81-NL-JS(SC))
(BAe-SS/1109; ESA-CR(P)-1819-Vol-1; ETN-87-90511)
Copyright Avail: NTIS HC A04/MF A01

It is shown that it is feasible to manufacture a basic module from which arrays of various sizes can be constructed within acceptable limits defined by power losses and power to weight criteria in the range from 15 to 30 kW, in steps of 2 kW, with a choice of low (52 V) or high (156 V) operating voltage levels. This modular design can be extended to provide array system powers up to 60 kW, although above 30 kW, only the high voltage operating level is practical, due to the high resistive power losses associated with the length of array, hence harness, required for such operating power levels. Operating levels are 30 W/kg at 15 kW and 42 W/kg at 30 kW. These levels could be increased by optimizing the design for specific operating power levels, but at the expense of modularity. It is unlikely that the 50 W/kg goal can be reached. Author (ESA)

N88-17107# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Stuttgart (West Germany). Gruppe Solarenergiewandlung.
PERFORMANCE OF HIGHLY CONCENTRATING MIRROR COLLECTORS AND COLLECTOR SYSTEMS
Rainer Koehne and Juergen Kleih Jun. 1987 68 p In GERMAN; ENGLISH summary Report will also be announced as translation (ESA-TT-1098)
(DFVLR-FB-87-29; ISSN-0171-1342; ETN-88-91451) Avail: NTIS HC A04/MF A01; DFVLR, Colog ne, Fed. Republic of Germany DM 21

The optical performances of axisymmetric mirror collectors and mirror systems were investigated, and the theoretically obtainable thermal efficiencies were estimated. The focusing concentration ratio of solar collectors and collector systems has a decisive influence on the obtainable thermal efficiency, but is strongly affected by errors of the mirror surfaces (sigma value). The concentration ratios of parabolic and spherical mirror and mirror systems, including secondary concentrators, were geometrically calculated. The sigma-dependent radiant flux density was determined using the HELIOS computer program. For sigma between 1.5 and 6 mrad, ratios between 1000 and 8000 are found for parabolic mirrors, and between 600 and 2000 for spherical mirrors. The maximum thermal efficiencies range between 55 percent and 80 percent for receiver temperatures between 400 and 800 C. ESA

N88-17108# Technische Hogeschool, Delft (Netherlands).
THERMAL ENERGY STORAGE BY MEANS OF AN ABSORPTION CYCLE Ph.D. Thesis
Johannes Petrus Ruiter 1987 156 p
(ETN-88-91614) Avail: NTIS HC A08/MF A01

A model for the absorption cycle was used to investigate 18 working pairs. Results show that the volumetric energy density of an absorption cycle with NH3/H2O as a working pair is more than twice that of heat storage in water, despite the separate storage of both components. A cycle with a compressor is more favorable than one with a heat pump. The calculated energetic efficiency of a cycle with components separated by supply of heat is 68 percent, that of a cycle with the compressor is 94 percent, based on primary energy. The model was verified for cycles with the first and third storage alternatives, for a mixture (NH3/H2O) as well as for a solution (NH3/NaSCN). An experimental installation was built with a net heat output of 5 kW and a storage capacity of 40 kWh. Experimental results agree within 9 percent with the model. ESA

N88-17109# Dortmund Univ. (West Germany). Lehrstuhl fuer Physikalische Chemie.
PHYSICO-CHEMICAL STUDIES ON COPPER SULFIDE BEHAVIOR IN THE CdS-Cu2S SOLAR CELL Final Report, 30 Sep. 1986
Hans Rickert, Christoph Filthaut, and Hans-Dieter Wiemhoefer Bonn, West Germany Bundesministerium fuer Forschung und Technologie Feb. 1987 90 p In GERMAN; ENGLISH summary
(Contract BMFT-03E-8115-A)
(ETN-88-91068) Avail: NTIS HC A05/MF A01

Behavior of copper sulfide (transport processes, conductivity) in contact with materials used in solar cells; and properties of possible ternary compounds, which are formed at these contacts, and their influence on the stability of copper sulfide were investigated. Current-voltage curves of copper sulfide in contact with different materials (steel, graphite, brass, silver, platinum) were obtained. Limits of stability were evaluated under the essential work-conditions of thin film solar cells in the form of maximum voltages, at which degradation of copper sulfide occurs. The chemical processes at silver contacts on copper sulfide and their influence on the stability of copper sulfide are derived from a thermodynamical model and corresponding electrochemical measurements. According to this a ternary Cu-Ag-S-system with another stability range and conductivity is formed by diffusion of silver into copper sulfide. ESA

N88-17110# Sandia National Labs., Albuquerque, N. Mex.
VAWT (VERTICAL-AXIS WIND TURBINE) STOCHASTIC LOADS PRODUCED BY ATMOSPHERIC TURBULENCE
Gregory F. Homicz 1987 11 p Presented at the 7th Wind Energy Symposium, New Orleans, La., 10 Jan. 1988
(Contract DE-AC04-76DP-00789)
(DE88-001355; SAND-87-1256C; CONF-880132-2) Avail: NTIS HC A03

Blade fatigue life is an important element in determining the economic viability of the Vertical-Axis Wind Turbine (VAWT). A principal source of blade fatigue is thought to be the stochastic (i.e., random) aerodynamic loads created by atmospheric turbulence. This paper discusses the development of a model for the simulation of these stochastic loads, given the rotor geometry, operating conditions, and assumed turbulence properties. A Double-Multiple-Streamtube analysis is employed, which includes the effects of wind shear. Reynolds number variations, different airfoil sections and chord lengths along the blade span, and an empirical model for dynamic stall effects. Calculations are presented for the VAWT 34-m Test Bed currently being assembled at Bushland, Texas. Time histories of the loads, as well as their Fourier spectra, are presented and discussed. An unexpected finding is that the average output power is predicted to be more sensitive to turbulence level than had previously been thought. DOE

N88-17111# Sandia National Labs., Albuquerque, N. Mex.
A COMPARISON OF THE PREDICTED AND MEASURED GRAVITATIONAL STRESSES IN VAWT (VERTICAL AXIS WIND TURBINE) BLADES
H. J. Sutherland and T. D. Ashwill 1987 6 p Presented at the 7th Wind Energy Symposium, New Orleans, La., 10 Jan. 1988
(Contract DE-AC04-76DP-00789)
(DE88-002113; SAND-87-1371C; CONF-880132-1) Avail: NTIS HC A02/MF A01

During the erection of the Sandia 34-Meter VAWT Test Bed, the induced gravitational stress state in the turbine blades and their associated deflections were measured. This manuscript details the measurements that were taken on the Test Bed blades during erection and compares them to the stresses and deflections predicted by the NASTRAN finite element code. DOE

N88-17112# Sandia National Labs., Albuquerque, N. Mex.
DATA ACQUISITION AND ANALYSIS SYSTEM FOR THE SANDIA 34-METER VERTICAL AXIS WIND TURBINE
D. Berg, M. Rumsey, L. Gallo, and D. Burwinkle 1987 7 p Presented at the 7th Wind Energy Symposium, New Orleans, La., 10 Jan. 1988 Prepared in cooperation with New Mexico Univ., Albuquerque
(Contract DE-AC04-76DP-00789)
(DE88-002417; SAND-87-1082C; CONF-880132-3) Avail: NTIS HC A02

Sandia National Laboratories has designed and built a 34-meter Vertical Axis Wind Turbine. Acquisition, storage, reduction, display, and analysis of the extensive data from this machine are accomplished with the use of a minicomputer-based data acquisition and analysis system. This paper discusses the development of that system and describes the vendor-supplied computer-system hardware and software, analog-to-digital converter hardware, and the Sandia-developed data acquisition and analysis software that is now operational. Plans for future enhancements of the system are also discussed. DOE

N88-17113# Sandia National Labs., Albuquerque, N. Mex.
A COMPARISON OF DIFFERENT MODULE CONFIGURATIONS FOR MULTIBANDGAP SOLAR CELLS
J. M. Gee 1987 10 p Presented at the 8th SERI Photovoltaics Advanced Research and Development Project Review Meeting, Denver, Colo., 15 Nov. 1987
(Contract DE-AC04-76DP-00789)
(DE88-002718; SAND-87-2035C; CONF-871114-1) Avail: NTIS HC A02/MF A01

The use of different module configurations with multijunction (MJ) solar cells was investigated. Module configuration refers to the electrical circuit in which the subcells of the MJ cell are connected. The simplest configuration has the subcells connected in series. The subcells may also be connected in parallel or operated independently. These circuits require MJ cells with more than two terminals. The performance of two-junction tandem cells with the different module configurations was analyzed by means of computer modelling. Roughly the same performance was found for an optimized MJ cell with the different module configurations. However, several advantages for MJ cells with the subcells wired in parallel as opposed to series were identified, including wider selection of bandgaps for optimal performance, less sensitivity to spectral variations, and possibly less sensitivity to radiation damage. DOE

N88-17114# Metalux S.p.A., Musile di Piave (Italy).
SOLAR ASSISTED ABSORPTION OR MOTOR DRIVEN HEAT PUMP WITH EARTH SEASONAL STORAGE, PART 1 Final Report, 1 Jul. 1982 - 30 Jun. 1985
R. M. Lazzarin 1986 78 p
(DE88-900191; EUR-10614-Pt-1) Avail: NTIS (US Sales Only) HC A05/MF A01

A plant composed of an energy roof, a seasonal earth storage and an absorption heat pump has been tested. The purpose was to study the behavior of the various components and their interaction. The surveys went on during two years. The following operations are considered: the charging of the earth storage by the energy roof and the working of an absorption heat pump connected either to the energy roof or to the earth storage. DOE

N88-17115# Oak Ridge National Lab., Tenn.
VALUE-ASSESSMENT OF ENERGY STORAGE CONCEPTS IN BURST POWER SYSTEMS
M. Siman-Tov, M. Olszewski, and D. E. Klett 1987 5 p Presented at the 5th Symposium on Space Nuclear Power Systems, Albuquerque, New Mexico, 11 Jan. 1988 Prepared in cooperation with North Carolina Agricultural and Technical State Univ., Greensboro
(Contract DE-AC05-84OR-21400)
(DE87-013756; CONF-880122-1) Avail: NTIS HC A02/MF A01

Due to the pulsed nature of burst power demands, energy storage can be considered to effect reductions in overall system mass and reduce the area requirements for radiators. Incorporation of energy storage allows subsystems (i.e., radiator, energy conversion cycle) to be sized for orbital average duty. Without

storage these systems must be sized to meet peak demands. Storage technologies include thermal (TES) and regenerable electrical energy (RES) storage. Technologies targeted for RES include flywheels, fuel cells and batteries. DOE

N88-16773# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).
SATELLITE POWER SYSTEMS UNDER CONSIDERATION BY THE UNITED NATIONS
D. Kassing *In its* ESA Bulletin No. 25 Feb. 1981 p 53-59
(For primary document see N88-16767 09-12)
Avail: NTIS HC A05/MF A01

45 ENVIRONMENT POLLUTION

Includes atmospheric, noise, thermal, and water pollution.

N88-17116# Lawrence Livermore National Lab., Calif. Atmospheric and Geophysical Sciences Div.
SIMULATION OF GLOBAL WET AND DRY DEPOSITION OF NITRIC ACID IN A THREE-DIMENSIONAL CHEMISTRY-TRANSPORT MODEL
John J. Walton, Donald J. Wuebbles, and Sultan Hameed (State Univ. of New York, Stony Brook.) May 1987 12 p Presented at the International Rain Conference, Lisbon, Portugal, 1-3 Sep. 1987 Prepared incooperation with State Univ. of New York, Stony Brook.
(Contract W-7405-eng-48)
(DE87-009847; UCRL-96286; CONF-870977-1) Avail: NTIS HC A03/MF A01

Estimated sources of NO sub x in combustion are p rescribed in the model as functions of latitude and longitude. The model calculates the conversion of NO sub x to HNO3, horizontal and vertical transport, and dry and wet deposition of these species. The calculated atmospheric distribution and deposition of NO sub x and HNO3 are compared with observations and found to be in general agreement. DOE

N88-17117# Pacific Northwest Labs., Richland, Wash.
ESTIMATION OF AERIAL DEPOSITION AND FOLIAR UPTAKE OF XENOBIOTICS: ASSESSMENT OF CURRENT MODELS
S. O. Link, R. J. Fellows, D. A. Cataldo, J. G. Droppo, and P. VanVoris Oct. 1987 92 p
(Contract DE-AC06-76RL-01830)
(DE88-000993; PNL-6173) Avail: NTIS HC A05/MF A01

This report reviews existing mathematical and/or computer simulation models that estimate xenobiotic deposition to and transport through (both curricular and stomatal) vegetative surfaces. The report evaluates the potential for coupling the best of those models to the existing Uptake, Translocation, Accumulation, and Biodegradation model to be used for future xenobiotic exposure assessments. Here xenobiotic compounds are defined as airborne contaminants, both organic and gaseous pollutants, that are introduced into the environment by man. Specifically this document provides a detailed review of the state-of-the-art models that addressed aerial deposition of particles and gases to foliage; foliar and cuticular transport, metabolism, and uptake of organic xenobiotics; and stomatal transport of gaseous and volatile organic xenobiotic pollutants. Where detailed information was available, parameters for each model are provided on a chemical by chemical as well as species by species basis. Sufficient detail is provided on each model to assess the potential for adapting or coupling the model to the existing UTAB plant exposure model. DOE

N88-17118# Pacific Northwest Labs., Richland, Wash.
A COMPARISON OF MULTI-LAYER MESO-ALPHA MLAM MODEL RESULTS WITH SURFACE AND AIRCRAFT OBSERVATIONS FROM CAPTEX
W. E. Davis, A. R. Olsen, B. T. Didier, and D. W. Damschen Mar. 1987 12 p Presented at the 16th International Technical Meeting on Air Pollution Modelling and its Application, Lindau, Fed. Republic of Germany, 6 Apr. 1987
(Contract DE-AC06-76RL-01830)
(DE88-000549; PNL-SA-14287; CONF-870444-4) Avail: NTIS HC A03/MF A01

A multi-layer regional-scale transport model with vertical motion, MLAM, was modified to run on the meso-alpha scale. The model was run on this scale to test the effects of wind shear and vertical redistribution due to mixing in the model against the observed surface and aircraft air concentrations. The CAPTEX (Cross Appalachian Tracer Experiment) data base was chosen because both surface and aircraft observations were available to compare with model results. Two CAPTEX cases were studied. Aircraft observations for one case showed an elevated plume with concentrations approximately 10 to 30 times greater aloft than at the surface. The second case was chosen because the plume spread less than the first case. Comparisons between the model results and observations in these two cases provide a means of testing the effect of shear and redistribution. DOE

N88-17119# Pacific Northwest Labs., Richland, Wash.
USER'S GUIDE TO A DATA BASE OF CURRENT ENVIRONMENTAL MONITORING PROJECTS IN THE US-CANADIAN TRANSBOUNDARY REGION
M. Y. Ballinger, J. Defferding, E. G. Chapman, M. D. Bettinson, and C. S. Glantz Nov. 1987 84 p
(Contract DE-AC06-76RL-01830)
(DE88-002476; PNL-6377) Avail: NTIS HC A05/MF A01

This document describes how to use a data base of current transboundary region environmental monitoring projects. The data base was prepared from data provided by Glantz et al. (1986) and Concord Scientific Corporation (1985), and contains information on 226 projects with monitoring stations located within 400 km (250 mi) of the US-Canadian border. The data base is designed for use with the dBASE III PLUS data management systems on IBM-compatible personal computers. Data-base searches are best accomplished using an accompanying command file called RETRIEVE or the dBASE command LIST. The user must carefully select the substrings on which the search is to be based. Example search requests and subsequent output are presented to illustrate substring selections and applications of the data base. DOE

N88-17120# Department of Energy, Washington, D. C. Office of Health and Environmental Research.
RADON RESEARCH PROGRAM, FY-1987
Nov. 1987 49 p Prepared in cooperation with Lovelace Biomedical and Environmental Research Inst., Albuquerque, N. Mex.
(Contract DE-AC04-76EV-01013)
(DE88-002633; DOE/EV-01013/H1) Avail: NTIS HC A03/MF A01

This program summary documents the radon-related research activities supported by the Office of Health and Environmental Research (OHER) during FY-1987. It includes scientific background, research program goals, and summaries in the availability and transport of radon in the environment, and into and within homes. Also included are summaries of physical-chemical interactions of radon progeny in ambient air and the lung cancer risk to the public from exposure to radon progeny. The main goal is to reduce uncertainties in evaluating health risks to people from inhaling radon and its progeny in indoor air. DOE

N88-17121# Oak Ridge Associated Universities, Inc., Tenn.
COMMITTEE ON INTERAGENCY RADIATION RESEARCH AND POLICY COORDINATION Annual Report No. 3, 1 Jul. 1986 - 30 Jun. 1987
30 Jun. 1987 15 p
(Contract DE-AC05-76OR-00033)
(DE88-003358; ORAU-87/J-78) Avail: NTIS HC A03/MF A01

During its third year the Committee on Interagency Radiation Research and Policy Coordination (CIRRPC) issued two reports of national importance and addressed 12 issues, six of which will be discussed in reports scheduled for issuance within the first

several months of its fourth year of operation. The two reports are the report on the guidance for US policy on use of the international system of units for radiation quantities and measurements, issued in December 1986, and the report identifying the radiation exposure issues associated with the exposure to radon naturally occurring in houses and buildings, issued in August 1986. A listing of the Executive Committee members, agencies' representatives, science panel members and science and policy panel participants are contained in section IV.A. CIRRPC's reporting and organizational structure and Oak Ridge Associated Universities (ORAU) technical assistance staff is contained in section IV.B. DOE

46 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; ionospheric and magnetospheric physics; and geomagnetism.

For space radiation see *93 Space Radiation.*

N88-17122# Aerospace Corp., El Segundo, Calif.
A MULTIPLE-SATELLITE OBSERVATION OF THE HIGH-LATITUDE AURORAL ACTIVITY ON 11 JANUARY 1983
David J. Gorney, Paul F. Mizera, D. S. Evans, and M. S. Gussenhoven 1 Nov. 1986 31 p
(Contract F04701-85-C-0086)
(AD-A175170; SD-TR-86-68; TR-0086(6940-05)-15) Avail: NTIS HC A03/MF A01 CSCL 04A

Unusual high latitude auroral activity occured on 11 January 1983 during a period of persistent IMF B sub z greater than 0, B sub y greater than 0 and B sub x greater than 0. This activity, which lasted from 6:00 to 21:00 UT, was characterized by numerous high latitude sun-aligned arcs and a diffuse oval. Near 15:00 UT a single broad (250 km) sun-aligned arc was observed by the optical linescan system on DMSP-F6. The arc was contiguous with the dawn auroral oval and extended across the northern polar cap, similar to previously reported theta aurora configurations. The orbital locations of the satellites allowed a detailed analysis of the precipitating particle populations responsible for both the sun-aligned arc and oval auroras. Author

N88-17123*# Illinois Univ., Urbana-Champaign. Electro-Optic Systems Lab.
RAYLEIGH LIDAR OBSERVATIONS OF GRAVITY WAVE ACTIVITY IN THE STRATOSPHERE AND LOWER MESOSPHERE
M. S. Miller, C. S. Gardner, and C. H. Liu Dec. 1987 66 p
(Grants NsG-5049; NSF ATM-86-10142)
(NASA-CR-182384; NAS 1.26:182384; UILU-ENG-87-2554; EOSL-87-008) Avail: NTIS HC A04/MF A01 CSCL 08E

Forty-two monochromatic gravity wave events were observed in the 25 to 55 km altitude region during 16 nights of Rayleigh lidar measurements at Poker Flat, Alaska and Urbana, Illinois. The measured wave parameters were compared to previous radar and lidar measurements of gravity wave activity. Vertical wavelengths, lambda(z), between 2 and 11.5 km with vertical phase velocities, c(z), between 0.1 and 1 m/s were observed. Measured values of lambda(z) and c(z) were used to infer observed wave periods, T(ob), between 50 and 1000 minutes and horizontal wavelengths, lambda(x), from 25 to 2000 km. Dominant wave activity was found at vertical wavelengths between 2 to 4 km and 7 to 10 km. No seasonal variations were evident in the observed wave parameters. Vertical and horizontal wavelengths showed a clear tendency to increase with T(ob), which is consistent with recent sodium lidar studies of monochromatic wave events near the mesopause. Measured power law relationships between the wave parameters were lambda(z) varies as T(ob) sup 0.96, lambda(x) varies as T(ob) sup 1.8, and c(z) varies as T(ob) sup -0.85. The kinetic energy calculated for the monochromatic wave events varied as k(z) sup -2, k(x) sup -1, and f(ob) sup -1.7. The atmospheric scale heights calculated for each observation date range from 6.5 to 7.6 km with a mean value of 7 km. The increase of rms wind perturbations with altitude indicated an amplitude growth length of 20.9 km. The altitude profile of kinetic energy density decreased with height, suggesting that waves in this altitude region were subject to dissipation or saturation effects. M.G.

N88-17124# Nexus Associates, Wayland, Mass.
ERROR ANALYSIS FOR GEOTECHNICAL ENGINEERING Final Report
Gregory Baecher Sep. 1987 131 p
(Contract DACW39-83-M-0067)
(AD-A186795; WES/CR/GL-87-3) Avail: NTIS HC A07/MF A01 CSCL 12A

This report provides an introduction to practical techniques of error analysis for geotechnical engineering. The intended audience is the practicing geotechnical engineer with little background in probability or statistics. An analysis procedure is presented by which errors entering geotechnical calculations can be quantified and their effect on predictive accuracy evaluated. The approach involves three phases: identification of potential sources of error; assessment of the magnitude of each source; and determination of the influence of each source on calculations. A companion report, provides related introductory material on the statistical analysis of geotechnical site-characterization data. GRA

N88-17125# Naval Postgraduate School, Monterey, Calif.
NUMERICAL INVESTIGATION OF OROGRAPHICALLY ENHANCED INSTABILITY M.S. Thesis
Gerald T. Byrne Sep. 1987 60 p
(AD-A186841) Avail: NTIS HC A04/MF A01 CSCL 04B

The NEPRF spectral baroclinic primitive equation model with six layers was numerically integrated over time to examine the effects that vertical wind profiles have on the development of lee cyclogenesis. In addition, the model was run in both linear and nonlinear modes to isolate their effects on the tests. The objective was to simulate a cold front moving over a high mountain ridge, similar to the Alps or Rockies, by implementing a wind reversal profile and to determine if this was conductive to lee cyclogenesis. It was found that the wind reversal profile produced favorable cyclonic growth, particularly when the model was in a linear mode. A nonlinear wind reversal test also produced positive results but only for a relatively short time; subsequently, nonlinear interactions dampened cyclonic growth considerably. In addition, two tests were run that allowed the mountain to grow in a very short time to isolate inertial gravity wave interactions. The gravity waves did produce considerable oscillations in the two tests, but after 15 hours or so these two tests showed similar cyclonic growth to the previous tests. GRA

N88-17126# Sandia Corp., Livermore, Calif.
X-RAY MICROFLUORESCENCE ANALYSIS OF THIN- AND THICK-SECTIONED GEOLOGIC MATERIALS
D. R. Boehme Apr. 1987 15 p
(Contract DE-AC04-76DR-00789)
(DE87-009803; SAND-87-8214) Avail: NTIS HC A03/MF A01

X-ray microfluorescence (XRMF) combined with simultaneous elemental digital mapping provides a new analytical tool for the elemental analyses of thick and thin sectioned metallurgical, geological, biological, and other types of materials. The penetrating nature of the X-ray beam allows elemental information to be obtained not only from the surface of the sample, but from beneath the sample surface (5 to 100+ microns depending on the sample elemental composition and the X-ray source used). The depth information when combined with the requirement for little or no sample preparation and the ability of the XRMF method to examine materials in air enhances the utility of the microfluorescence and digital mapping technique. Furthermore, the combination of the depth information from the XRMF method and surface information (typically only 1 to 2 microns in depth) from electron optical methods makes for a more complete analysis of a sample. Geologic materials are good specimens to illustrate the XRMF and data analysis technique because of the variety of other analytical techniques that can be used for verification of the XRMF method. Three different geologic specimens were examined by XRMF to

illustrate the capability of the technique to detect small elemental variations within a specimen, to image microscopic objects within a larger sample matrix, and to obtain elemental information from beneath the sample surface resulting from the penetration of the X-ray beam. The information obtained by the XRMF method was corroborated by optical microscopy, scanning electron microscopy-SEM, and electron microprobe analysis-EPMA. DOE

N88-17127# Naval Postgraduate School, Monterey, Calif.
F-LAYER POLAR CAP ARCS M.S. Thesis
Denise D. Fite Sep. 1987 58 p
(AD-A186592) Avail: NTIS HC A04/MF A01 CSCL 04A

Two types of ionospheric anomalies have been discovered recently in the polar cap: patches and arcs. Polar cap arcs are the focus of this study, which seeks correlation between arcs and total election content (TEC) enhancements and amplitude scintillation effects. Simultaneous optical and radio frequency measurements were taken at Thule AFB and Qanaaq, Greenland, using the All-Sky Imaging Photometer (ASIP) and a specially equipped Global Positioning System (GPS) receiver. Arcs were discovered to produce significant, rapidly varying TEC increases, and small but measurable amplitude scintillation. GRA

N88-17128# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
THE EFFECTS OF A GEOMAGNETIC STORM ON THERMOSPHERIC CIRCULATION M.S. Thesis
Douglas G. Brinkman 1987 109 p
(AD-A186638; AFIT/CI/NR-87-111T) Avail: NTIS HC A06/MF A01 CSCL 04A

The motions of the thermosphere and its interactions with the ionosphere during a geomagnetic storm are of current interest to space scientists. A two dimensional model was used to simulate the thermospheric response to the impulsive high-latitude heating associated with a geomagnetic storm. The storm-induced motions can be characterized by an initial period of transient waves followed by the development of a mean circulation. These motions generate an electrical current system that is on the same order of magnitude as, and in the opposite sense to, the normal s sub q current system. Model-simulated winds and electrical currents were then compared to observations. GRA

N88-17129# Observatoire du Mont-Gros, Nice (France).
LITERATURE SURVEY RELATING TO THE ABSORPTION PROPERTIES OF OZONE IN THE NEAR ULTRAVIOLET
Nicole Berruyer-Desirotte Paris, France ESA Feb. 1972 42 p In FRENCH; ENGLISH summary
(ESRO-SM-81; ETN-87-90504) Avail: NTIS HC A03/MF A01

In preparation for ballroom-borne observations in the ultraviolet, the absorption properties of ozone were reviewed. The results of laboratory studies to determine the absorption coefficients and the effect that temperature and pressure have on these coefficients are described. Data on the distribution of atmospheric ozone as a function of latitude, longitude, time of year, time of day and altitude, are given. Methods of measuring residual ozone are outlined. Tables for the calculation of atmospheric absorption; value of the coefficients of absorption of ozone, variation of the refraction index of the air as a function of wavelength are presented. ESA

N88-17130# Royal Inst. of Tech., Stockholm (Sweden). Dept. of Plasma Physics.
PRELIMINARY RESULTS FROM THE dc ELECTRIC FIELD EXPERIMENT ON VIKING
C.-G. Faelthammar, L. P. Block, P.-A. Lindqvist, G. Marklund, A. Pedersen, and F. S. Mozer (California Univ., Berkeley.) Mar. 1987 17 p Presented at the Symposium on Auroral Dynamics, 11th Assembly of the European Geophysical Society, Kiel, USSR, 25-29 Aug. 1986 Submitted for publication
(TRITA-EPP-87-03; ISSN-0348-7539; ETN-88-91678) Avail: NTIS HC A03/MF A01

Electric field measurements up to 13,500 km altitude are discussed. In nonauroral regions the electric field has the general character expected from extrapolation along magnetic field lines of previously known low-altitude electric field distributions. A pronounced feature of the data is the prevalence of strong localized and highly structured electric fields above the auroral oval. The border between such fields and the quiet electric fields equatorward of the oval can be extremely sharp. The electric fields are usually transverse to the magnetic field; cases of magnetic-field aligned components are revealed. A variety of ULF waves are found in the electric field data. Because of the generally high Alfven velocity in the upper parts of the Viking orbit, the electric fields of ULF waves are easily measured even where their magnetic fields are below detectability. ESA

N88-17131# Royal Inst. of Tech., Stockholm (Sweden). Dept. of Plasma Physics.
ACCELERATION OF AURORAL PARTICLES BY MAGNETIC FIELD-ALIGNED ELECTRIC FIELDS
Lars P. Block Jun. 1987 29 p Submitted for publication
(TRITA-EPP-87-08; ISSN-0348-7539; ETN-88-91679) Avail: NTIS HC A03/MF A01

Measurements on the S3-3 and Swedish Viking satellites appear to show that at least a large fraction of magnetic field-aligned potential drops are made up of multiple double layers. Solitons and double layers in U-shaped potential structures give rise to spikey electric fields also perpendicular to the magnetic field in agreement with satellite measurements. The large scale potential structures associated with inverted V-events are built up of many similar short-lived structures on a small scale. Viking measurements indicate that electric fields parallel to the magnetic field are almost always directed upward. ESA

N88-17132# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany). Inst. fuer Physik der Atmosphaere.
NUMERICAL SIMULATION OF THERMALLY GENERATED MOUNTAIN-FORELAND CIRCULATION Ph.D. Thesis - Technische Univ., Munich, Federal Republic of Germany
Franz Somieski Jul. 1987 190 p In GERMAN; ENGLISH summary
(DFVLR-FB-87-30; ISSN-0171-1342; ETN-88-91690) Avail: NTIS HC A09/MF A01; DFVLR, Cologne, Federal Republic of Germany DM 56.50

The thermally generated mountain-foreland circulation was simulated using a hydrostatic mesoscale model. For an idealized large mountain valley, the influence of different mountain shapes and surface properties on the energy budget and the mountain and valley winds was determined. The importance of the mountain structure, the mean orographic height of the valley catchment area, the volume effect, advection, surface evaporation, thermal soil parameters, and snow cover are shown. ESA

N88-17133# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany). Inst. fuer Physik der Atmosphaere.
THE ACCURACY OF THE RADIATION PARAMETERIZATION IN MESOSCALE MODELS [ZUR GENAUIGKEIT DER STRAHLUNGSPARAMETERISIERUNG IN MESOSKALIGEN MODELLEN]
Bernd Dietrich, Peter Koepke, Karl-Theodor Kriebel, Ralph Meerkoetter, Heinrich Quenzel (Ludwig-Maximilians-Universitaet, Munich, West Germany), and Franz Somieski 12 Mar. 1985 8 p In GERMAN
(DFVLR-IB-553-85/11; ETN-88-91012) Avail: NTIS HC A02/MF A01

A parameterized and a nonparameterized mesoscale atmospheric circulation model were compared in order to quantify the accuracy of the atmospheric radiation parameterization. The intercomparison was made using benchmark codes and the modified Pielke model. The spectrum was divided into the solar and terrestrial domain, and the radiation transfer equation was solved. The modified Pielke model gives for the downwards radiation flux densities at the soil, values that are 15 to 30 W/sqm too high. The heating rates resulting from the modified Pielke model are within the error bars of the benchmark codes. ESA

N88-17134# GKSS-Forschungszentrum Geesthacht (West Germany). Inst. fuer Physik.
CONCEPT, CONSTRUCTION, AND EXPERIMENTAL TESTING OF A POLYCHROMATOR FOR A RAMAN LIDAR FOR THE SIMULTANEOUS TELEMETERING OF CARBON DIOXIDE AND WATER VAPOR, RELATIVE TO OXYGEN Thesis - Hamburg Univ., Federal Republic of Germany [KONZEPTION, AUFBAU UND EXPERIMENTELLE ERPROBUNG EINES POLYCHROMATORS FUER EIN RAMAN-LIDAR ZUR SIMULTANEN FERNMESSUNG VON KOHLENDIOXID UND WASSERDAMPF RELATIV ZU SAUERSTOFF]
E. Voss 16 Mar. 1987 162 p In GERMAN; ENGLISH summary
(GKSS-87/E/20; ISSN-0344-9629; ETN-88-91050) Copyright Avail: NTIS HC A08/MF A01

A polychromator was designed for wavelength separation in Raman lidar measurements of concentration height profiles of CO2 and H2O. Theoretical considerations for the selection of plane gratings, imaging elements, and the arrangement of the components are given. Experiments were performed for the characterization of the optical elements, emphasizing the efficiency of the gratings. The alignment and calibration procedures are described. The most important characteristics of the polychromator were measured, and their dependence on several parameters was determined. The perturbation of the CO2-channel count rate was calculated. The measured Raman spectra of CO2, H2O, and O2 demonstrate the suitability of the device. ESA

N88-17135# Cologne Univ. (West Germany). Mathematisch-Naturwissenschaftlichen Fakultaet.
MEASUREMENT OF VERTICAL DISTRIBUTIONS OF HALOGENATED HYDROCARBONS IN THE STRATOSPHERE Ph.D. Thesis [MESSUNG VON VERTIKALVERTEILUNGEN HALOGENIERTER KOHLENWASSERSTOFFE IN DER STRATOSPHAERE]
Dobroslawa Knapska 1986 175 p In GERMAN
(ETN-88-91065) Avail: NTIS HC A08/MF A01

A modified air sampler was tested on its suitability for a series of halogenated hydrocarbons and light hydrocarbons, with emphasis on stratospheric air sampling. This cryogenic air collection method was successfully used for the measurement of long-lived trace gases such as CH4, N2O, CFCl3, and CF2Cl2. The results provide representative vertical profiles of chlorinated hydrocarbons for medium latitudes of the Northern Hemisphere. The number of simultaneously measured trace gases, and the good height resolution of the profiles allow the study of large-scale transport phenomena as well as the clarification of open questions related to stratospheric chemistry. ESA

N88-17136# Institut fuer Angewandte Geodaesie, Frankfurt am Main (West Germany).
THE ANALYSIS OF RECENT CRUSTAL MOVEMENTS IN STATIC AND KINEMATIC MODELS [DIE ANALYSE REZENTER ERDKRUSTENBEWEGUNGEN IN STATISCHEN UND KINEMATISCHEN MODELLEN]
Dieter Ehlert 1987 268 p In GERMAN; ENGLISH summary
(Ser-B-279; ISSN-0071-9196; ETN-88-91090) Avail: NTIS HC A12/MF A01

Methods for the analysis of recent crustal movements and accompanying computer programs are presented, for static and kinematic evaluation of sets of coordinates of terrestrial points obtained by high precision satellite laser rangefinding during several observation periods. The static and kinematic adjustment models are presented. The adjustment algorithm and the verfication of the model assumptions are discussed. The computer program is enclosed. ESA

N88-17137# Gesamthochschule, Wuppertal (West Germany). Abteilung Physikalische Chemie.
INVESTIGATION OF OH REACTION PRODUCTS. EXCIMER LASER PHOTOLYSIS/SLAB LASER FLUORESCENCE UNDER TROPOSPHERIC CONDITIONS [UNTERSUCHUNG VON OH-REAKTIONEN MITTELS EXCIMERLASERPHOTOLYSE/FARBSTOFFLASERFLUORESZE NZ UNTER TROPOSPHAERISCHEN BEDINGUNGEN]
E. H. Fink and V. Schmidt Dec. 1985 100 p In GERMAN; ENGLISH summary
(Rept-8; ETN-88-91503) Avail: NTIS HC A05/MF A01

Absolute rate constants of OH reactions were measured up to total pressures of 1 bar and in the presence of strongly quenching gases. In the presence of O2, the effective disappearance rate of OH is diminished at all total pressures by a factor of 4 due to reproduction of OH by fast secondary processes. This can be described quantitatively by a reaction model, which includes a fast reaction of the OH+C2H2-adduct with O2, producing OH with a yield of 89 percent. Besides the decay of OH the formation and decay of vinoxy radicals as a minor intermediate product and the formation of glyoxal as a major product of the reaction in the presence of O2 could be followed with the LIF technique. Similar secondary reactions in the presence of O2 leading to reproduction of OH are found for the reactions of OH with propine and ethylenoxide. ESA

N88-17138# Stockholm Univ. (Sweden). Dept. of Meteorology.
SURFACE OZONE MEASUREMENTS AT A SWEDISH MOUNTAIN SITE
Robert Jansson Oct. 1987 37 p
(CM-72; ISSN-0280-445X; ETN-88-91669) Avail: NTIS HC A03/MF A01

Continuous ozone measurements were made on a 1250 m high mountain. Point measurements were made with a portable ozone monitor at selected sites on and in the vicinity. It is found that concentrations at the mountain site are unaffected by local anthropogenic sources and sinks and are representative of high elevation concentrations within 60 km of the site. Data for July and August show an average hourly ozone concentration of 32 ppbv, with day to day variations on the order of 10 ppbv. No diurnal pattern is observed excepting a 3 to 5 ppbv depression in concentration at 8 to 9 am. Periods of ozone highs with concentrations above 45 ppbv are observed on 4 occasions, associated with air mass trajectories from the south. ESA

N88-17139*# Johns Hopkins Univ., Baltimore, Md. Dept. of Earth and Planetary Sciences.
MESOSPHERIC DYNAMICS AND CHEMISTRY FROM SME DATA Semiannual Report, 1 Jul. 1986 - 31 Dec. 1987
Darrell F. Strobel 31 Dec. 1987 18 p
(Grant NAG5-796)
(NASA-CR-182465; NAS 1.26:182465) Avail: NTIS HC A03/MF A01 CSCL 04A

A fast Curtis matrix calculation of cooling rates due to the 15 micron band of CO2 is modified to parameterize the detailed calculations by Dickinson (1984) of infrared cooling by CO2 in the mesosphere and lower thermosphere. The calculations included separate NLTE treatment of the different 15 micron bands likely to be important for cooling. The goal was to compress the detailed properties of the different bands into a modified Curtis matrix, which represents one composite band with appropriate averaged radiative properties to allow for a simple and quick calculation of cooling rates given a temperature profile. Vertical constituent transport in the mesosphere was also studied. B.G.

N88-17140*# Nevada Univ., Reno. Dept. of Geological Sciences.
NATURE AND ORIGIN OF MINERAL COATINGS ON VOLCANIC ROCKS OF THE BLACK MOUNTAIN, STONEWALL MOUNTAIN, AND KANE SPRINGS WASH VOLCANIC CENTERS, SOUTHERN NEVADA Semiannual Progress Report, Jul. 1987 - Jan. 1988
James V. Taranik, Liang C. Hsu, and David Spatz Jan. 1988 53 p

(Contract NAS5-28765)
(NASA-CR-181437; NAS 1.26:181437) Avail: NTIS HC A04/MF A01 CSCL 08G

Comparative lab spectra and Thematic Mapper imagery investigations at 3 Tertiary calderas in southern Nevada indicate that desert varnish is absorbant relative to underlying host rocks below about 0.7 to 1.3 microns, depending on mafic affinity of the sample, but less absorbant than mafic host rocks at higher wavelengths. Desert varnish occurs chiefly as thin impregnating films. Distribution of significant varnish accumulations is sparse and localized, occurring chiefly in surface recesses. These relationships result in the longer wavelength bands and high 5/2 values over felsic units with extensive desert varnish coatings. These lithologic, petrochemical, and desert varnish controlled spectral responses lead to characteristic TM band relationships which tend to correlate with conventionally mappable geologic formations. The concept of a Rock-Varnish Index (RVI) is introduced to help distinguish rocks with a potentially detectable varnish. Felsic rocks have a high RVI, and those with extensive desert varnish behave differently, spectrally, from those without extensive varnish. The spectrally distinctive volcanic formations at Stonewall Mountain provide excellent statistical class segregation on supervised classification images. A binary decision rule flow-diagram is presented to aid TM imagery analysis over volcanic terrane in semi-arid environments. Author

N88-17141# Los Alamos National Lab., N. Mex.
INDUCED TURBULENCE IN AEROSOL-LOADED ATMOSPHERES, JUN. 1987
S. M. Chitanvis Aug. 1987 16 p Presented at the CRDEC Scientific Conference on Obscuration and Aerosol Research, Aberdeen, Maryland, Jun. 1987
(Contract W-7405-eng-36)
(DE87-014724; LA-UR-87-2728; CONF-8706199-2) Avail: NTIS HC A03

This paper considers the effects of a pulse of radiation from a high-energy laser beam on the ambient turbulence that exists in the atmosphere. The atmosphere is considered as a compressible, perfect gas being heated by the high-energy laser pulse. We compute correlation functions of the temperature in the isobaric regime. The two-point correlation function is changed by a multiplicative factor that grows exponentially in time while the pulse is on Empirical formulas permit us to connect temperature fluctuations that we can compute to the refractive index fluctuations of the atmosphere. These self-induced refractive index fluctuations will be useful in studying the propagation characteristics of high energy laser beams through the atmosphere. DOE

N88-17142# Los Alamos National Lab., N. Mex.
LOOKING FOR NEW GRAVITATIONAL FORCES WITH ANTIPROTONS
M. M. Nieto and B. E. Bonner 1987 15 p Presented at the 2nd Review and Planning Workshop on Antiproton Science and Technology, Santa Monica, California, 6 Oct. 1987 Prepared in cooperation with Rice Univ., Houston, Texas
(Contract W-7405-eng-36)
(DE88-003154; LA-UR-87-3941; CONF-8710125-5) Avail: NTIS HC A03/MF A01

Quite general arguments based on the principle of equivalence and modern field theory show that it is possible for the gravitational acceleration of antimatter to be different than that for matter. Further, there is no experimental evidence to rule out the possibility. In fact, some evidence indicates there may be unexpected effects. Thus, the planned experiment to measure the gravitational acceleration of antiprotons is of fundamental importance. DOE

N88-16770# European Space Agency. Centre Spatial de Toulouse (France). Earth Observation Program Office.
METEOSAT TRACKS KARMAN VORTEX STREETS IN THE ATMOSPHERE
P. Berlin *In its* ESA Bulletin No. 25 Feb. 1981 p 16-19
(For primary document see N88-16767 09-12)
Avail: NTIS HC A05/MF A01

N88-17427# Joint Publications Research Service, Arlington, Va.
MOVING IONOSPHERIC PERTURBATIONS INDUCED BY WAVE TRAINS PROPAGATING THROUGH OCEAN Abstract Only
V. I. Pavlov and A. I. Sukhorukov *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 27 Oct. 1987 p 50-51 Transl. into ENGLISH from Pisma v Zhurnal Tekhnicheskoy Fiziki (Leningrad, USSR), v. 13, no. 6, 26 Mar. 1987 p 351-354 Original language document was announced in IAA as A87-41896 (For primary document see N88-17395 09-70)
Avail: NTIS HC A04/MF A01

47 METEOROLOGY AND CLIMATOLOGY

Includes weather forecasting and modification.

N88-17143# European Space Agency. European Space Operations Center, Darmstadt (West Germany). Meteosat Exploitation Project.
METEOROLOGICAL INFORMATION EXTRACTION CENTER (MIEC) PROCESSING
W. R. Burke, ed. Sep. 1987 27 p
(ESA-STR-224; ISSN-0379-4067; ETN-88-91412) Copyright Avail: NTIS HC A03/MF A01

Radiative transfer, segment processing, and semitransparency correction of Meteosat images is described. Cloud motion vectors, sea surface temperatures, cloud analysis, cloud-top height, upper tropospheric humidity, and precipitation index are considered. The climate data set and the International Satellite Cloud Climatology Project are mentioned. ESA

N88-17144# Air Force Environmental Technical Applications Center, Scott AFB, Ill.
REVISED UNIFORM SUMMARY OF SURFACE WEATHER OBSERVATIONS. PARTS A-F: CARSWELL AFB, TEXAS Summary Report, Nov. 1942 - Jul. 1987
24 Nov. 1987 293 p
(AD-A186820; USAFETAC/DS-87/078) Avail: NTIS HC A13/MF A01 CSCL 04B

This report provides a statistical data summary of surface weather observations for: Carswell AFB, Texas. Summary consists of: Weather conditions and atmospheric phenomena; Atmospheric precipitation; Surface winds; Ceiling and visibility; Psychrometric summaries; Barometric pressure summaries. See USAFETAC/TN-83/001 (ADA132186), An Aid for Using the Revised Uniform Summary of Surface Weather Observations (RUSSWO) for complete description of contents and instructions for use. GRA

N88-17145# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
INTERACTION OF THE COLD CONVEYOR BELT WITH POLAR JET STREAKS M.S. Thesis
William D. Nicholas 1987 165 p
(Grant AFIT/CI/NR-87-44T)
(AD-A186774) Avail: NTIS HC A08/MF A01 CSCL 04B

Evaluation of the interaction of the low level Cold Moist Conveyor Belt (CMCB) with upper level jet streaks is accomplished using isentropic surfaces. Primary goals are: (1) to assess where the CMCB flows with respect to the low level flow and upper level jet streak; (2) to demonstrate that the CMCB plays a part in the transverse circulations for the upper jet streak entrance and exit regions; and (3) to isolate which physical parameters play an important role in modifying the low level transverse circulations of the CMCB as related to upper level jet streaks. Attempts to identify certain physical forcing mechanisms related to jet streaks revealed mixed results. Comparisons of the orientation of vertical motion fields in CMCB to jet streaks indicated varied contributions by diffluence, warm advection, jet streaks, and curvature in jet exit region. In jet entrance region, more consistent contributions by cold air devection, confluence, and curvature were observed

compatable with several theoretical and observational studies on curved jet streaks in the entrance region. GRA

N88-17146# European Space Agency, Paris (France).
INTRODUCTION TO THE METEOSAT SYSTEM
J. Morgan, comp. and B. Battrick, ed. Nov. 1981 65 p
(ESA-SP-1041; ISSN-0379-6566; ETN-87-90501) Copyright
Avail: NTIS HC A04/MF A01; ESA, Paris, France FF 55

The Meteosat satellite, radiometer, ground system, image processing, meteorological parameter extraction, data dissemination, data collection, archiving, and international global system are described. ESA

N88-17147# World Climate Programme, Geneva (Switzerland).
REPORT OF THE WORKSHOP ON SPACE SYSTEMS POSSIBILITIES FOR A GLOBAL ENERGY AND WATER CYCLE EXPERIMENT
May 1987 128 p Workshop held in Columbia, Md., 19-23 Jan. 1987
(WCP-137; WMO/TD-180; ETN-88-91683) Avail: NTIS MF A01; print copy available from WMO, Geneva, Switzerland

An experiment to study the transport of water (vapor, liquid, and solid) and energy fluxes in the global atmosphere and at the underlying surface; and to develop methods of predicting changes in the distribution of water (vapor, liquid, and solid) within the global atmosphere and on the underlying surface, which may occur naturally or through man's activity is presented. Global atmospheric models are reviewed. Techniques for global observation, and the contribution of spaceborne techniques are discussed. ESA

N88-17148# Ludwig-Maximilians-Universitaet, Munich (West Germany). Inst. fuer Meteorologie.
SIMULATIONS OF THERMALLY INDUCED WINDS AND CROSS FLOW SITUATIONS [SIMULATIONEN VON THERMISCH INDUZIERTEN WINDEN UND UEBERSTROEMUNGSSITUATIONEN]
Wolfgang Ulrich Feb. 1987 204 p In GERMAN
(Mitt-57; ETN-88-91056) Avail: NTIS HC A10/MF A01

A three-dimensional (3D) unsteady mesoscale simulation model was developed and tested for the simulation of local wind systems in case of crossflow or thermal excitation. Energy and mass conservation was emphasized. The choice of the equation system and the principal integration scheme for the 3D simulation model are discussed. The investigation of subgrid parameterization, as well as the boundary and initial conditions for the numerical simulations are outlined. The results show that a part of the surrounding energy conversion surfaces have to be taken into account for the development of valley wind systems. For a weakly stable stratification, an additional mountain-foreland crossflow is required to maintain a valley wind. Realistic valley winds were simulated, in good agreement with measurements. ESA

N88-17149# Technische Univ., Hanover (West Germany). Inst. fuer Meterologie und Klimatologie.
WIND MEASUREMENTS AT HIGH ALTITUDES (150 m TOWER) Final Report, Mar. 1984
Gerd Tetzlaff, Sabine Theunert, Axel Hoff, Wilhelm Ruhe, and Reinhard Trapp Bonn, West Germany Bundesministerium fuer Forschung und Technologie Dec. 1986 92 p In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie, Fed. Republic of Germany
(BMFT-FB-T-86-169; ISSN-0340-7608; ETN-88-91067) Avail: NTIS HC A05/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 19

In the period from October 1980 to December 1983 the wind velocity, wind direction, and air temperature were recorded as 2 min averaged values at heights of 10, 50, 100, and 150 m. The study of the geostrophic wind shows that the measuring period is representative for all seasons. The vertical wind profile was measured and confirmed by calculation. The average values of the wind velocities are in the range of former measurements and calculations, with an annual average value of 7.4 m/sec at a height of 50 m. The measured results confirm the wind data assumed for the Growian windpowered generator site. ESA

N88-17150# Stockholm Univ. (Sweden). Dept. of Meteorology.
A LAGRANGIAN MODEL OF DRY THERMALS
Bernt Olofsson Sep. 1987 61 p
(DM-50; ISSN-0349-0467; ETN-88-91670) Avail: NTIS HC A04/MF A01

Using the parcel method a simple Lagrangian model was constructed to investigate the relative importance of different parameters governing the character of dry convection. The dilution of the thermals is considered as a turbulent diffusion enhanced by internal circulation. Using experience from gliding the entrainment formula of the model was adjusted to obtain realistic updrafts and sizes of the thermals. The model shows that the initial acceleration of a thermal bubble is entirely due to the temperature difference between the thermal and the surrounding air. The consequent life story of the thermal is determined by its initial values (size and excess temperature), environmental conditions, and the intensity of the turbulence. A humidity mixing ratio decreasing with height in the surrounding air with a rate which is common below a dry inversion, enhances the thermal strength. Thermals, especially the small ones, are very sensitive to slight changes of the temperature lapse rate of the environment. ESA

N88-17151# National Oceanic and Atmospheric Administration, Boulder, Colo. Wave Propagation Lab.
CONVECTIVE WIND FIELDS AS INVESTIGATED WITH DOPPLER LIDAR
B. F. Weber Jul. 1987 117 p
(PB88-115472; NOAA-TM-ERL-WPL-148) Avail: NTIS HC A06/MF A01 CSCL 04B

The objective of the research was to evaluate a Doppler laser remote sensor (lidar) in the measurement of mean wind and the temporal and spatial distribution of convective elements and other perturbation features in the planetary boundary layer. Mean wind measurements from the lidar were compared to anemometry time series from the Boulder Atmospheric Observatory tower, to determine agreement between the different sensors. The lidar and tower mean flow estimates were found to agree within 1 m S-1 during a variety of weather conditions. Mean wind fields were removed from the lidar returns and perturbation fields were then examined. Features detected by the lidar were examined for consistency in time and space. The lidar was demonstrated to be a useful tool for the study of the time history and spatial distribution of perturbation fields. GRA

N88-17152*# Illinois State Water Survey, Champaign. Climate and Meteorology Section.
APPLICATION OF SATELLITE DATA IN VARIATIONAL ANALYSIS FOR GLOBAL CYCLONIC SYSTEMS Status Report
G. L. Achtemeier Feb. 1988 28 p
(Grant NAG8-059)
(NASA-CR-182468; NAS 1.26:182468) Avail: NTIS HC A03/MF A01 CSCL 04B

The goal of the research is a variational data assimilation method that incorporates as dynamical constraints, the primitive equations for a moist, convectively unstable atmosphere and the radiative transfer equation. Variables to be adjusted include the three-dimensional vector wind, height, temperature, and moisture from rawinsonde data, and cloud-wind vectors, moisture, and radiance from satellite data. In order to facilitate thorough analysis of each of the model components, four variational models that divide the problem naturally according to increasing complexity were defined. The research performed during the second year fall into four areas: sensitivity studies involving Model 1; evaluation of Model 2; reformation of Model 1 for greater compatibility with Model 2; development of Model 3 (radiative transfer equation); and making the model more responsive to the observations.

B.G.

N88-17153# Pacific Northwest Labs., Richland, Wash.
MODEL INVESTIGATIONS OF ATMOSPHERIC AMMONIA SCAVENGING
N. S. Laulainen, D. J. Luecken, and J. M. Hales May 1987 28 p Presented at the International Symposium on Ammonia and Acidification, Bilthoven, Netherlands, 14 Apr. 1987
(Contract DE-AC06-76RL-01830)
(DE88-002337; PNL-SA-14703; CONF-8704227-1) Avail: NTIS HC A03/MF A01

In this study, a one-dimensional reactive storm model was used to calculate vertical concentration profiles of atmospheric ammonia and to examine the behavior of these concentrations during precipitation events. The model was initially used to generate clear-air profiles that were found to be consistent with those reported in the literature. A simple, convective storm was then applied to these initial profiles to determine the response of the gaseous ammonia concentrations to the precipitation event. The vertical ammonia concentrations were found to be significantly depleted by the storm event, with the maximum depletion occurring in the cloud layer. This alteration can have potentially significant effects in calculated reaction rates and in the upward flux of ammonia to the stratosphere. Several different storm conditions were tested, and all cases displayed the same characteristic depleted profiles. Calculations were performed for gaseous and aqueous ammonia only to assess the usefulness of this method for determining the depletion of highly soluble atmospheric gases and to specify the minimum amount of gaseous ammonia depletion occurring during a precipitation event. DOE

N88-17154# Oregon State Univ., Corvallis.
DEVELOPMENT OF A PHYSICALLY-BASED GENERAL CIRCULATION MODEL PARAMETERIZATION OF CLOUDS AND THEIR RADIATIVE INTERACTIONS Final Report
M. E. Schlesinger Nov. 1987 87 p
(Contract W-7405-eng-48)
(DE88-004060; UCRL-15996) Avail: NTIS HC A05/MF A01

In this report we describe our current research under the development of a multi-layer GCM, the design of a physically-based parameterization of clouds, the analysis performed under the Pilot Program for the International Satellite Cloud Climatology Program (ISCCP), and the design of a solar radiation parameterization employing the two-stream and delta-Eddington approximations for multiple scattering. DOE

N88-17437# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Cologne (West Germany). Inst. fuer Physik der Atmosphaere.
THE RETARDATION OF COLD FRONTS AT HIGH MESOSCALE MOUNTAINS
Ulrich Schumann *In its* Scientific Colloquium in Honor of Prof. Dr. Rer. Nat. Hermann L. Jordan Jun. 1987 p 91-123 Original contains color illustrations (For primary document see N88-17432 09-70)
Avail: NTIS HC A07/MF A01; DFVLR, Cologne, Fed. Republic of Germany DM 29

48 OCEANOGRAPHY

Includes biological, dynamic, and physical oceanography; and marine resources.

For related information see also *43 Earth Resources and Remote Sensing.*

N88-17155# Naval Postgraduate School, Monterey, Calif.
SEA SURFACE CURRENT ESTIMATES OFF CENTRAL CALIFORNIA AS DERIVED FROM ENHANCED AVHRR (ADVANCED VERY HIGH RESOLUTION RADIOMETER) INFRARED IMAGES M.S. Thesis
Chung-Ming Fang Sep. 1987 51 p
(AD-A186867) Avail: NTIS HC A04/MF A01 CSCL 08C

A technique is presented which uses an interactive computer program to estimate sea surface current velocities from the displacement of Sea Surface Temperature (SST) patterns apparent in enhanced sequential infrared images obtained from the NOAA-6 Advanced Very High Resolution Radiometer (AVHRR). This technique was applied to the surface currents of the California current system using IR image data from 27 and 28 April 1981. This technique, which uses enhanced pseudocolor gradient imagery, produced more current vectors than an earlier technique developed by O'Hara (1987) which used unenhanced gray scale imagery. The resultant surface vectors agree well in direction but underestimate velocities obtained from Doppler Acoustic Log (DAL) measurements taken during the same period. The two methods produced closest agreement of current velocities of less than 40 cm/sec and with satellite-derived velocities obtained with sequential 12 hour images rather than sequential 24 hour images. Satellite-derived velocities in the rapid flow area (larger than 40 cm/sec) showed poor correspondence to DAL-measured velocities. The strong current shear in these areas may distort the surface SST patterns making identification of features between two images more difficult. GRA

N88-17156# Army Cold Regions Research and Engineering Lab., Hanover, N.H.
PHYSICAL PROPERTIES OF SUMMER SEA ICE IN THE FRAM STRAIT, JUNE-JULY 1984
Anthony J. Gow, Walter B. Tucker, III, and Wilford F. Weeks Sep. 1987 92 p
(AD-A186937; CRREL-87-16) Avail: NTIS HC A05/MF A01 CSCL 08L

Most of the ice sampled was multi-year; it is estimated to represent at least 84 percent by volume of the total ice discharged from Fram Strait during June and July. Thicknesses and other properties indicated that none of the multi-year ice was older than 4 to 5 years. Snow cover on the multi-year ice averaged 29 cm deep while that on first-year averaged only 8 cm. Much of this difference appears to be the result of enhanced sublimation of the snow on the thinner first-year ice. Salinity profiles of first-year ice clearly show the effects of ongoing brine drainage in that profiles from cores drilled later in the experiment were substantially less saline than earlier cores. Bulk salinities of multi-year ice are generally much lower than those of first-year ice. This difference furnished a reliable means of distinguishing between the two ice types. Thin section examinations of crystal structure indicate that about 75 prcent of the ice consisted of congelation ice with typically columnar crystal structure. The remaining 25 percent consisted of granular ice with only a few occurrences of snow ice. The granular ice consisted primarily of frazil, found in small amounts at the top of floes, but mainly observed in multi-year ridges where it occurred as the major component of ice in interblock voids. The horizontally oriented crystal c-axes showed varying degrees of alignment, from negligible to strong, in which the alignment direction changed with depth, implying a change in floe orientation with respect to the ocean current at the ice/water interface during ice growth. GRA

N88-17157# Army Cold Regions Research and Engineering Lab., Hanover, N.H.
EVALUATION OF THE MAGNETIC INDUCTION CONDUCTIVITY METHOD FOR DETECTING FRAZIL ICE DEPOSITS
Steven A. Arcone, Bruce E. Brockett, Daniel E. Lawson, and Edward F. Chacho, Jr. Sep. 1987 16 p
(AD-A186940; CRREL-87-17) Avail: NTIS HC A03/MF A01 CSCL 17F

The ability to map frazil ice deposits and water channels beneath an ice-covered river in central Alaska using the magnetic induction conductivity (MI) technique were assessed. The study was performed during the first week of March of 1986 on the Tanana River near Fairbanks and employed a commercially available instrument operating at a fixed frequency with a fixed antenna (coil) spacing and orientation. Comparisons of the MI data with theoretical models based upon physical data measured along three cross sections of the river demonstrate the sensitivity of the MI technique to frazil ice deposits. The conductivity generally derived for the frazil ice deposits encountered is very low (approx. .00063 S/m) when compared with the measured value for water

(approx. 0.011 S/m), and is similar to the calculated values for gravel and sandy gravel bed sediments. In all three cross sections, maxima in the apparent conductivity profiles correlated with frazil ice deposits. Difficulties, possibly due to adverse effects of cold weather upon instrument calibration, affected the quantitative performance of the instrument on one cross section, although the interpretation of the data (locations of open channels vs frazil deposits) was qualitatively unaffected. GRA

N88-17158# Royal Australian Navy Research Lab., Edgecliff.
OCEANOGRAPHIC FEATURES OF THE EAST AND SOUTHEAST INDIAN OCEAN FOR JUNE 1983
L. J. Hamilton Feb. 1987 31 p
(AD-A186948; RANRL-TM-3/87; DODA-AR-003-463) Avail: NTIS HC A03/MF A01 CSCL 08C

During the period late May to late June 1983 two research vessels and seven ships of opportunity transited sections of the south-east and east Indian Ocean. Expendable bathy thermographs were deployed and several Nansen stations occupied, providing a rare occasion of wide-spread quasisynoptic data coverage for the area. Satellite imagery is available from two sources and three satellite tracked drifting buoys were in the area. Data are used to form a broad scale description of oceanographic conditions for the period, with more detailed analysis possible in the area north-west of Australia. Comparisons are made with data from the Indian Ocean Expedition of early 1960s and other sources. The relation of surface thermal patterns to circulation is examined. GRA

N88-17159# Coastal Engineering Research Center, Vicksburg, Miss.
NEARSHORE WAVE TRANSFORMATION STUDY OF SITES NEAR PORT CANAVERAL INLET, FLORIDA Final Report
Willie A. Brown, Rebecca M. Brooks, and Edward F. Thompson Sep. 1987 48 p
(AD-A186965; CERC-MP-87-16) Avail: NTIS HC A03/MF A01 CSCL 08C

This report describes a 20-year summary of nearshore wave estimates of shoaling and transformation of waves in the vicinity of Cape Canaveral. The objective of this study was to obtain data which could be used in determining sediment transport in the Port Canaveral Inlet. These data consisted of breaking wave conditions at five different sites along the coastline near Port Canaveral Inlet. GRA

N88-17160# Washington Univ., Seattle. School of Oceanography.
NORTH PACIFIC OCEAN. CENTRAL PACIFIC TRANSITION ZONE, R/V THOMAS G. THOMPSON: 25 MARCH - 3 MAY 1968. STD DATA REPORT
Gunnar I. Roden and William J. Fredericks 1987 284 p
(Contracts N00014-67-A-0103; N00014-84-C-0111)
(AD-A186570; CONTRIB-1716) Avail: NTIS HC A13/MF A01 CSCL 08C

During March and April 1968, scientists aboard the R/V Thomas G. Thompson studied the thermohaline and density structures in the subarctic-subtropical transition zone of the central North Pacific. Additional hydrographic sections were made north of Kahuka Point, Oahu. Of the 130 STD stations planned for this area, 127 were completed and 3 were lost because of weather. The primary objectives of the field study were: (1) to investigate the mesoscale thermohaline and density structures in long meridional high resolution sections across the subarctic and subtropical boundaries; (2) to determine the mesoscale signatures of the subarctic and subtropical fronts at the boundaries of the transition zone; (3) to study the mesoscale dynamic height and baroclinic flow structures across the transititon zone; and (4) to access the submesoscale thermohaline and baroclinic flow variabiltiy in the vicinity of the Hawaiian Ridge. GRA

N88-17161# Washington Univ., Seattle. School of Oceanography.
NORTH PACIFIC OCEAN. NORTHEAST PACIFIC TRANSITION ZONE, R/V THOMAS G. THOMPSON: 1 NOVEMBER - 6 DECEMBER 1969. STD DATA REPORT
Gunnar I. Roden and William J. Fredericks 1987 515 p
(Contracts N00014-67-A-0103; N00014-84-C-0111)
(AD-A186574; CONTRIB-1717) Avail: NTIS HC A22/MF A01 CSCL 08C

During Nov. and Dec., 1969 scientists aborad the R/V Thomas G. Thompson studied the thermohaline and density structures in the transition zones between the California current, the trade wind circulation, the outflow from the Gulf of California, and the north equatorial current. Most of the investigations were concentrated off Baja California, the Revilla Gigedos Island region, and across the mouth of the Gulf of California. Of the 254 STD stations planned, 249 were completed; four were lost and one was omitted, because the water in lee of Isla Clarion, Mexico was too shallow. The primary objectives of the field study were: (1) to investigate the mesoscale thermohaline and density structures in the transition zones associated with the outer boundaries of the California current; (2) to study the frontal structures in the Revilla Gigedos islands region, where the California current, the outflow from the Gulf of California, and the north equatorial current intermingle; (3) to determine the mesoscale thermohaline and baroclinic flow structure across the mouth of the Gulf of California by very high resolution hydrographic sections. GRA

N88-17162# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
ACTIVE AND PASSIVE REMOTE SENSING OF ICE Semiannual Report, 1 Feb. - 31 Jul. 1987
Jin A. Kong 31 Jul. 1987 11 p
(Contract N00014-83-K-0258)
(AD-A186685) Avail: NTIS HC A03/MF A01 CSCL 08L

We have studied volume scattering effects of snow-covered sea ice with a three-layer random medium model for microwave remote sensing. Strong fluctuation theory and bilocal approximation are applied to calculate the effective permittivities for snow and sea ice. Wave scattering theory, in conjunction with the distorted Born approximation, is then used to compute bistatic coefficients and backscattering cross sections. We also derived a general mixing formula for discrete scatterers immersed in a host medium. The results are applicable to general multiphase mixtures, and the scattering ellipsoids of the different phases can have different sizes and arbitrary ellipticity distribution and axis orientation, i.e., the mixture may be isotropic or anisotropic. The Mueller matrix and polarization covariance matrix are described for polarimetric radar systems. Clutter is modelled by a layer of random permittivity, described by a three-dimensional correlation function, with variance, and horizontal and vertical correlation lengths. Study of the strong fluctuation theory for a bounded layer of random discrete scatterers is extended to include high-order co-polarized and cross-polarized second moments. We have derived the dyadic Green's function for a two-layer anisotropic medium. GRA

N88-17163 GKSS-Forschungszentrum Geesthacht (West Germany). Inst. fuer Physik.
INVESTIGATION OF THE QUANTITATIVE DETERMINATION OF TWO DIMENSIONAL SEA SURFACE WAVE SPECTRA FROM SHIPBORNE RADAR MEASUREMENTS Thesis - Hamburg Univ., Fed. Republic of Germany [UNTERSUCHUNG ZUR QUANTITATIVEN BESTIMMUNG ZWEIDIMENSIONALER SEEGANGSSPEKTREN AUS MESSUNGEN MIT NAUTISCHEM RADAR]
F. Ziemer 3 Dec. 1987 158 p In GERMAN; ENGLISH summary
(GKSS-87/E/10; ISSN-0344-9629; ETN-88-91047) Copyright Avail: Fachinformationszentrum, Karlsruhe, Fed. Republic of Germany

A shipborne microwave system (X-band) for routine imaging of sea surface waves is presented. The applied measurement and analysis technique provides the asymmetric energy density spectra

versus wavenumber components with a very high signal to noise ratio. Deviations of the wave energy from the dispersion shell give the amount and direction of near-surface current. The radar results agree well with those of other measurements. The image transfer function was investigated by measurements and computer simulations. The observed effects of antenna viewing direction, distance from the imaged scene, and average wave height were parameterized, providing a first step toward the development of a self calibrating system. ESA

N88-17164# Kiel Univ. (West Germany). Inst. fuer Meereskunde.
HYDROGRAPHIC AND CURRENT MEASUREMENTS IN THE NORTH-EAST ATLANTIC OCEAN. DATA REPORT ON F.S. METEOR CRUISES 69/5 AND 69/6, OCTOBER TO NOVEMBER 1984
T. J. Mueller, M. Finke, W. Dasch, and R.-R. Wittstock 1987 110 p
(Rept-166; ISSN-0341-8561; ETN-88-91471) Avail: NTIS HC A06/MF A01

Hydrographic data and 1 year long records from 6 mooring sites in the NE Atlantic Ocean between 20 N and 41 N and east of 27 W were collected. Sections of temperature, salinity, and density by an in situ calibrated CTD-system; sections from expendable bathythermograph casts; measurements of a geomagnetic electro-kinetograph, and near surface temperature and salinity are shown. From current meter mooring site (33 N, 22 W) the continuation of low pass filtered time series started in 1980 is shown. Five further sites along 28 N were equipped with 2 long (400 m) thermistor cable moorings and a current meter in the main thermocline. ESA

N88-17165# Kiel Univ. (West Germany). Inst. fuer Meereskunde.
ANALYSIS OF LOW FREQUENCY CURRENT FLUCTUATIONS IN THE NORTH-EAST ATLANTIC OCEAN Thesis
T. J. Mueller 1987 146 p In GERMAN; ENGLISH summary
(Rept-170; ISSN-0341-8561; ETN-88-91472) Avail: NTIS HC A07/MF A01

Eulerian current measurements from 13 positions in the Atlantic between 28 N and 42 N and east of 27 W are analyzed. Most of the time series are from the main thermocline and 200 to 380 days long; for position N1, (33 N, 22 W) the series are 2049 days long. Mean current vectors confirm the mean baroclinic circulation pattern inferred from historical data but show higher velocities. Integral time scales of the fluctuative part of the currents are of the order of 20 to 30 days. Only the east component on position N1 has an extremely long integral time scale (70 days). The level of the fluctuative part of kinetic energy is moderate according to position and depth. In the northern Canary basin it has a maximum in the range 50 to 200 days. Neither in the currents nor in their variances is a seasonal signal detected. The zonal component at N1 shows a very slowly varying signal of 3.5 year period. Barotropic and the first baroclinic mode contain greater than 80 percent of the fluctuative part of the energy. ESA

N88-17166# Old Dominion Univ., Norfolk, Va. Research Foundation.
CONTINENTAL SHELF PROCESSES AFFECTING THE OCEANOGRAPHY OF THE SOUTH ATLANTIC BIGHT Progress Report, 1 Jun. 1987 - 31 May 1988
L. P. Atkinson Jan. 1988 37 p
(Contract DE-FG05-85ER-60348)
(DE88-004102; DOE/ER-60348/7; TR-87-12) Avail: NTIS HC A03/MF A01

This study of continental shelf processes affecting the oceanography of the South Atlantic Bight (SAB) is part of the interdisciplinary DOE-sponsored South Atlantic Bight Program. Our part of the program involves hydrographic and nutrient characteristics of the region. Current research efforts in the SAB Program are being focused on the inner shelf region where effects of bottom friction, local wind forcing, river and estuarine discharge, and tides, which are all small scale processes, are important. Our major accomplishment during the past year was the completion of the FLEX (Fall Experiment) field study. Since most of our data collection is computerized, preliminary hydrographic data analysis was done on board ship during the cruise and preliminary results are available. These results will be presented in this report. We are just beginning our standard data processing and data analysis procedures. We continued the processing and analysis of SPREX data collected during April 1985. Work has also continued on the older GABEX I and II data sets. DOE

N88-17167# Academy of Sciences (USSR), Moscow. Soviet Geophysical Committee.
MATERIALS OF THE WORLD DATA CENTER B. DEEP SEISMIC SOUNDING (DSS): PACIFIC DATA
[1987] 108 p In RUSSIAN; ENGLISH summary
Avail: NTIS HC A06/MF A01

The catalog contains results obtained by the method of deep seismic sounding in the Pacific Ocean in experiments begun in 1948 to 1950 and then continued into the early 1980's. The tables of velocity values and thickness of Earth crustal layers, the parameters of the M boundary as well as schemes of seismic sections for more detailed studies are presented. The tables are compiled on the basis of previous publications and available summaries. The distinctive feature of the catalog is that the tables give the information based on observational methods. To demonstrate, the legend chosen on the basis of the analysis of the system of travel-time curves, and the characteristics of sources and receivers are taken into account. This approach allows the scientists to evaluate the relative reliability of each section. The peculiarities of the method are indicated in the study map showing the areas of investigations. Author

51 LIFE SCIENCES (GENERAL)

N88-17168*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
SPACE BIOREACTOR SCIENCE WORKSHOP
Dennis R. Morrison, ed. Dec. 1987 183 p Workshop held in Houston, Tex., 22-23 Aug. 1985
(NASA-CP-2485; S-564; NAS 1.55:2485) Avail: NTIS HC A09/MF A01 CSCL 06B

The first space bioreactor has been designed for microprocessor control, no gaseous headspace, circulation and resupply of culture medium, and a slow mixing in very low shear regimes. Various ground based bioreactors are being used to test reactor vessel design, on-line sensors, effects of shear, nutrient supply, and waste removal from continuous culture of human cells attached to microcarriers. The small (500 ml) bioreactor is being constructed for flight experiments in the Shuttle middeck to verify systems operation under microgravity conditions and to measure the efficiencies of mass transport, gas transfer, oxygen consumption, and control of low shear stress on cells. Applications of microcarrier cultures, development of the first space bioreactor flight system, shear and mixing effects on cells, process control, and methods to monitor cell metabolism and nutrient requirements are among the topics covered. For individual titles, see N88-17169 through N88-17180.

N88-17169*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
SUSPENSION CELL CULTURE IN MICROGRAVITY AND DEVELOPMENT OF A SPACE BIOREACTOR
Dennis R. Morrison *In its* Space Bioreactor Science Workshop Dec. 1987 p 1-18 (For primary document see N88-17168 09-51)
Avail: NTIS HC A09/MF A01 CSCL 06B

NASA has methodically developed unique suspension type cell and recovery apparatus culture systems for bioprocess technology experiments and production of biological products in microgravity. The first space bioreactor has been designed for microprocessor

control, no gaseous headspace, circulation and resupply of culture medium, and slow mixing in very low shear regimes. Various ground based bioreactors are being used to test reactor vessel design, on-line sensors, effects of shear, nutrient supply, and waste removal from continuous culture of human cells attached to microcarriers. The small (500 ml) bioreactor is being constructed for flight experiments in the Shuttle middeck to verify systems operation under microgravity conditions and to measure the efficiencies of mass transport, gas transfer, oxygen consumption, and control of low shear stress on cells. Author

N88-17170*# Technology, Inc., Houston, Tex.
SPACE BIOREACTOR: DESIGN/PROCESS FLOW
John H. Cross *In* NASA. Lyndon B. Johnson Space Center, Space Bioreactor Science Workshop Dec. 1987 p 19-27 (For primary document see N88-17168 09-51)
Avail: NTIS HC A09/MF A01 CSCL 06B

The design of the space bioreactor stems from three considerations. First, and foremost, it must sustain cells in microgravity. Closely related is the ability to take advantage of the weightlessness and microgravity. Lastly, it should fit into a bioprocess. The design of the space bioreactor is described in view of these considerations. A flow chart of the bioreactor is presented and discussed. Author

N88-17171*# Technology, Inc., Houston, Tex.
BIOREACTOR DESIGN CONCEPTS
William Bowie *In* NASA. Lyndon B. Johnson Space Center, Bioreactor Science Workshop Dec. 1987 p 29-39 (For primary document see N88-17168 09-51)
Avail: NTIS HC A09/MF A01 CSCL 06B

Two parallel lines of work are underway in the bioreactor laboratory. One of the efforts is devoted to the continued development and utilization of a laboratory research system. That system's design is intended to be fluid and dynamic. The sole purpose of such a device is to allow testing and development of equipment concepts and procedures. Some of the results of those processes are discussed. A second effort is designed to produce a flight-like bioreactor contained in a double middeck locker. The result of that effort has been to freeze a particular bioreactor design in order to allow fabrication of the custom parts. The system is expected to be ready for flight in early 1988. However, continued use of the laboratory system will lead to improvements in the space bioreactor. Those improvements can only be integrated after the initial flight series. Author

N88-17172*# Technology, Inc., Houston, Tex.
COMPUTER CONTROL OF A MICROGRAVITY MAMMALIAN CELL BIOREACTOR
William A. Hall *In* NASA. Lyndon B. Johnson Space Center, Space Bioreactor Science Workshop Dec. 1987 p 41-57 (For primary document see N88-17168 09-51)
Avail: NTIS HC A09/MF A01 CSCL 06B

The initial steps taken in developing a completely menu driven and totally automated computer control system for a bioreactor are discussed. This bioreactor is an electro-mechanical cell growth system cell requiring vigorous control of slowly changing parameters, many of which are so dynamically interactive that computer control is a necessity. The process computer will have two main functions. First, it will provide continuous environmental control utilizing low signal level transducers as inputs and high powered control devices such as solenoids and motors as outputs. Secondly, it will provide continuous environmental monitoring, including mass data storage and periodic data dumps to a supervisory computer. Author

N88-17173*# Rice Univ., Houston, Tex. Dept. of Chemical Engineering.
SHEAR AND MIXING EFFECTS ON CELLS IN AGITATED MICROCARRIER TISSUE CULTURE REACTORS
Robert S. Cherry and E. Terry Papoutsakis *In* NASA. Lyndon B. Johnson Space Center, Space Bioreactor Science Workshop Dec. 1987 p 59-75 (For primary document see N88-17168 09-51)
Avail: NTIS HC A09/MF A01 CSCL 06B

Tissue cells are known to be sensitive to mechanical stresses imposed on them by agitation in bioreactors. The amount of agitation provided in a microcarrier or suspension bioreactor should be only enough to provide effective homogeneity. Three distinct flow regions can be identified in the reactor: bulk turbulent flow, bulk laminar flow and boundary-layer flows. Possible mechanisms of cell damage are examined by analyzing the motion of microcarriers or free cells relative to the surrounding fluid, to each other and to moving or stationary solid surfaces. The primary mechanisms of cell damage appear to result from: (1) direct interaction between microcarriers and turbulent eddies; (2) collisions between microcarriers in turbulent flow; and (3) collisions against the impeller or other stationary surfaces. If the smallest eddies of turbulent flow are of the same size as the microcarrier beads, they may cause high shear stresses on the cells. Eddies the size of the average interbead spacing may cause bead-bead collisions which damage cells. The severity of the collisions increases when the eddies are also of the same size as the beads. Impeller collisions occur when beads cannot avoid the impeller leading edge as it advances through the liquid. The implications of the results of this analysis on the design and operation of tissue culture reactors are discussed. Author

N88-17174*# Houston Univ., Tex. Dept. of Chemical Engineering.
SOME PROCESS CONTROL/DESIGN CONSIDERATIONS IN THE DEVELOPMENT OF A MICROGRAVITY MAMMALIAN CELL BIOREACTOR
Charles F. Goochee *In* NASA. Lyndon B. Johnson Space Center, Space Bioreactor Science Workshop Dec. 1987 p 77-91 (For primary document see N88-17168 09-51)
Avail: NTIS HC A09/MF A01 CSCL 06B

The purpose is to review some of the physical/metabolic factors which must be considered in the development of an operating strategy for a mammalian cell bioreactor. Emphasis is placed on the dissolved oxygen and carbon dioxide requirements of growing mammalian epithelial cells. Literature reviews concerning oxygen and carbon dioxide requirements are discussed. A preliminary, dynamic model which encompasses the current features of the NASA bioreactor is presented. The implications of the literature survey and modeling effort on the design and operation of the NASA bioreactor are discussed. Author

N88-17175*# BioChem Technology, Inc., Malvern, Pa.
FED-BATCH CONTROL BASED UPON THE MEASUREMENT OF INTRACELLULAR NADH
W. B. Armiger, J. F. Lee, L. M. Montalvo, and J. R. Forro *In* NASA. Lyndon B. Johnson Space Center, Space Bioreactor Science Workshop Dec. 1987 p 93-103 (For primary document see N88-17168 09-51)
Avail: NTIS HC A09/MF A01 CSCL 06B

A series of experiments demonstrating that on-line measurements of intracellular NADH by culture fluorescence can be used to monitor and control the fermentation process are described. A distinct advantage of intercellular NADH measurements over other monitoring techniques such as pH and dissolved oxygen is that it directly measures real time events occurring within the cell rather than changes in the environment. When coupled with other measurement parameters, it can provide a finer degree of sophistication in process control. Author

N88-17176*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
NUTRIENT REQUIREMENTS AND OTHER FACTORS INVOLVED IN THE CULTURE OF HUMAN KIDNEY CELLS ON MICROCARRIER BEADS
Marian L. Lewis (Technology, Inc., Houston, Tex.) and Dennis R. Morrison *In its* Space Bioreactor Science Workshop Dec. 1987 p 105-119 (For primary document see N88-17168 09-51)
Avail: NTIS HC A09/MF A01 CSCL 06B

The culture of human kidney cells on microcarrier beads in the Bioprocessing Laboratory at the Johnson Space Center is described. These were the first series of studies performed before and during 1983 to determine optimum conditions, including medium type, bead type and density. The composition of several medium types and the molecular weights of some common culture medium supplements and cellular proteins are included. The microgravity cell-to-bead attachment experiment performed on Space Transportation System Flight 8 is described. Author

N88-17177*# State Univ. of New York, Stony Brook. Dept. of Biochemistry.
PLANT CELL TECHNOLOGIES IN SPACE: BACKGROUND, STRATEGIES AND PROSPECTS
A. D. Kirkorian and H. W. Scheld (Phytoresource Research, Inc., College Station, Tex.) *In* NASA. Lyndon B. Johnson Space Center, Space Bioreactor Science Workshop Dec. 1987 p 121-144 (For primary document see N88-17168 09-51)
Avail: NTIS HC A09/MF A01 CSCL 06B

An attempt is made to summarize work in plant cell technologies in space. The evolution of concepts and the general principles of plant tissue culture are discussed. The potential for production of high value secondary products by plant cells and differentiated tissue in automated, precisely controlled bioreactors is discussed. The general course of the development of the literature on plant tissue culture is highlighted. Author

N88-17178*# Lovelace Biomedical and Environmental Research Inst., Albuquerque, N. Mex. Div. of Biomedical Research.
POTENTIAL USE OF THE BIOREACTOR TO DETERMINE EFFECTS OF MICROGRAVITY AND OTHER ENVIRONMENTAL PARAMETERS ON GROWTH OF HYBRIDOMA CELLS
Kenneth D. Ley *In* NASA. Lyndon B. Johnson Space Center, Space Bioreactor Science Workshop Dec. 1987 p 145-146 (For primary document see N88-17168 09-51)
Avail: NTIS HC A09/MF A01 CSCL 06B

It is argued that the bioreactor being developed at NASA will allow researchers to determine the optimal conditions (e.g., pH, O sub 2, CO sub 2, nutrients) for growth of hybridoma cells, and to determine whether cell growth and antibody production are enhanced in the microgravity of space. Author

N88-17179*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
DESIGN CONCEPTS FOR BIOREACTORS IN SPACE
P. K. Seshan, G. R. Peterson, B. Beard, C. Boshe, and E. H. Dunlop (Washington Univ., Seattle.) *In* NASA. Lyndon B. Johnson Space Center, Space Bioreactor Science Workshop Dec. 1987 p 147-159 Previously announced as N86-19926 (For primary document see N88-17168 09-51)
Avail: NTIS HC A09/MF A01 CSCL 06B

Microbial food sources are becoming viable and more efficient alternatives to conventional food sources, especially in the context of closed ecological life support systems (CELSS) in space habitats. Two bioreactor design concepts presented represent two dissimilar approaches to grappling with the absence of gravity in space habitats and deserve to be tested for adoption as important components of the life support function aboard spacecraft, space stations and other extra-terrestrial habitats. R.J.F.

N88-17180*# Technology, Inc., Houston, Tex.
CELL CULTURE EXPERIMENTS PLANNED FOR THE SPACE BIOREACTOR
Dennis R. Morrison and John H. Cross *In* NASA. Lyndon B. Johnson Space Center, Space Bioreactor Science Workshop Dec. 1987 p 161-178 (For primary document see N88-17168 09-51)
Avail: NTIS HC A09/MF A01 CSCL 06B

Culturing of cells in a pilot-scale bioreactor remains to be done in microgravity. An approach is presented based on several studies of cell culture systems. Previous and current cell culture research in microgravity which is specifically directed towards development of a space bioprocess is described. Cell culture experiments planned for a microgravity sciences mission are described in abstract form. Author

52 AEROSPACE MEDICINE

Includes physiological factors; biological effects of radiation; and effects of weightlessness on man and animals.

N88-17181# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
A-SCAN ULTRASOUND MEASUREMENT OF OCULAR CHANGES DURING ACCOMMODATION M.S. Thesis
Dennis L. Smith Apr. 1987 225 p
(AD-A186818; AFIT/CI/NR-87-42T) Avail: NTIS HC A10/MF A01 CSCL 06E

An A-mode ultrasound unit was used to investigate how the principle refractive surfaces of the eye changed during the act of accommodation. Sixteen volunteers took part in an investigation where changes were studied in both the cycloplegied and noncycloplegied state. Measurements of axial length, anterior chamber, lens thickness, and vitreous chamber depth were made at three different accommodation response levels over time. These results showed no significant change in axial length or vitreous chamber depth of the eye from cycloplegia to any accommodative response level. The depth of the anterior chamber and thickness of the lens showed significant changes at each of the three accommodative response levels. The results are consistent with the Helmholtz-Fincham theory of accommodation. This study also demonstrated the time course of action of two drops of 1 percent cyclopentolate with full cyclopentolate cycloplegia reached between 35 and 45 minutes for subjects with dark irides. GRA

N88-17182# Army Research Inst. of Environmental Medicine, Natick, Mass.
ROLE OF BODY FAT IN THE PREDICTION OF THE METABOLIC RESPONSE FOR IMMERSION IN COLD WATER
Peter Tikuisis, Richard R. Gonzalez, Robert A. Oster, and Kent B. Pandolf Jun. 1987 24 p
(AD-A186914; USARIEM-M44-87) Avail: NTIS HC A03/MF A01 CSCL 06J

Several empirical models for predicting the metabolic response to a lowered body temperature were evaluated against available data of young healthy males immersed in cold water under resisting conditions. Nude immersions took place in 20 and 24 C water for 1 hour and clothed immersions took place in 10 and 15 C for 3 hours. The data were pooled according to low and high percent body fat (percent BF). Decreases in the mean weighted skin temperature (Tsk) ranged from 5.3 to 11.9 C and decreases in the core temperature (Tc) ranged from 0.56 to 1.54 C, while increases in the metabolic rate over the immersion period ranged from 34 to 256 W. Through regression analysis, an inverse relationship between percent BF and the metabolic response for a given lowered Tsk and lowered Tc was established. When this relationship was explicitly applied to the models, significant improvements in their predictive capability were found. Variables such as body weight, body surface area and rate of change of Tsk were not found to contribute to the predictive capability of the models. Physiology effects; Hypothermia. GRA

N88-17183# Texas A&M Univ., College Station. Bioengineering Program.
VITAL SIGNS RATE METER Final Report, Oct. 1985 - Sep. 1986
Charles S. Lessard, Wing C. Wong, Eric T. Schorsch, Jae-Joong Im, and Steve Mesibov Sep. 1987 52 p
(Contract F33615-83-D-0602)
(AD-A187015; USAFSAM-TR-87-14) Avail: NTIS HC A04/MF A01 CSCL 06L

The design of the vital signs rate meter described in this report is an outgrowth from previous studies on noninvasive measurement methods and systems for vital signs detection. The purpose of the vital signs rate meter is to assist medical technicians

in performance of triage within a toxic environment. Two of the primary physiological measures obtained during an emergency assessment are respiration rate and heart rate. The vital signs rate meter is a combination of hardwired circuits and programmable logic (software). The prototype rate meter includes a microphone and a set of dry electrodes as the sensor array. A simple holder was designed to hold the sensors. Separate signal lines connect the transducers to the electronic circuits enclosed in an aluminum box. Analog signal detection and preconditioning are accomplished with analog circuitry. The conditioned signal is converted into binary format as input to the digital signal processing part of the device. A microprocessor is used as the basis for a design which provides flexibility and potential for future expansion of the device. Programs were written to perform additional signal conditioning, identification of signal, calculation of rates and control of display rate and format. The vital signs rate meter measures and displays heart rate and respiration rate in a digital format. GRA

N88-17184# New York Univ., New York.
BIOPHYSICAL AND BIOCHEMICAL MECHANISMS IN SYNAPTIC TRANSMITTER RELEASE Annual Report, 1 Sep. 1986 - 31 Aug. 1987
Rodolfo R. Llinas 28 Sep. 1987 13 p
(Grant AF AFOSR-0368-65)
(AD-A187059; AFOSR-87-1496TR) Avail: NTIS HC A03/MF A01 CSCL 06A

Four major goals were accomplished in the second year. Two related to synapsin 1 regulation of transmitter release and two related to the temperature dependence of the synaptic release process with a preliminary study of quantal release at the squid giant synapse. The results may be summarized as follows: (1) Demonstration that the dephosphorylated tail fragments of synapsin 1 do not regulate synaptic release which excludes the possibility that tail fragments themselves can prevent vesicular release. (2) Injection of head phospho synapsin 1 does not regulate synaptic release, demonstrating that the molecule itself does not interfere with vescular fusion. These two experiments indicate that synapsin 1 works by affixing the synaptic vesicles to the cytoskeletal system. (3) Video-enhanced microscopy results demonstrated that axoplasmic mobility is not altered by either tail fragments or head phospho synapsin 1, confirming the findings obtained by the electrophysiological study. The results demonstrate the mechanism by which synapsin 1 regulates transmitter release. A study of the temperature dependence of transmitter release demonstrated that temperature can be used to study the kinetics of synapsin 1 inhibition of transmitter release. Measurements of miniature potentials were finally accomplished routinely and can now be utilized as a technique to determine directly the effect of synapsin 1 on single vesicular fusion. GRA

N88-17185# Vermont Univ., Burlington. Coll. of Medicine.
MOLECULAR MECHANISMS OF NEURONAL RESPONSIVITY Final Scientific Report, 15 Jan. 1986 - 15 May 1987
Yigal Ehrlich 10 Jul. 1987 19 p
(Grant AF AFOSR-0089-86)
(AD-A187061; AFOSR-87-1463TR) Avail: NTIS HC A03/MF A01 CSCL 06B

This paper lists the registrants scheduled to attend the conference and a list of papers presented in the field of Molecular mechanisms of neuronal responsivity. GRA

N88-17186# Army Research Inst. of Environmental Medicine, Natick, Mass.
THE ROLE OF HYDRATION ON PERIPHERAL RESPONSE TO COLD Final Report
Donald E. Roberts and Joel J. Berberich 6 Aug. 1987 21 p
(AD-A186448) Avail: NTIS HC A03/MF A01 CSCL 06J

Ten men were dehydrated by restriction of fluid intake and by exercise over 2-1/2 days (weight loss: 4.6%), Body weight returned to -1.6% within 10 hours after rehydration, suggesting the weight loss was fluid loss. Measures of blood and urine constituents also were indicative of dehydration. These subjects experienced a cold test prior to and after dehydration and after rehydration. The fingers, but not the back of the hand, of the dehydration group were significantly colder (P less than 0.5) following dehydration. A group of 10 control subjects tested under identical conditions, but hydrated at all times, showed no changes. GRA

N88-17187# National Aerospace Medical Centre, Soesterberg (Netherlands).
DOES THE KNIFE OPEN PERSPECTIVES FOR THE MYOPIC PILOT? [BIEDT HET MES PERSPECTIEF AAN DE BIJZIENDE VLIEGER?]
A. C. H. vandenHeuvel Jun. 1985 19 p In DUTCH
(ETN-87-90166) Avail: NTIS HC A03/MF A01

Research on radial keratotomy for myopia was reviewed. Post operation results, degree of myopia correction, the factors that affect the results of keratotomy, and complications are discussed. The present status does not encourage positive advice as to radial keratotomy for pilots, especially for professional pilots. ESA

N88-16757# Eidgenoessische Technische Hochschule, Zurich (Switzerland). Lab. fuer Biochemie.
WHITE BLOOD CELLS IN SPACE: AN EXPERIMENT FOR THE FIRST SPACELAB MISSION
A. Cogoli and A. Tschopp *In* ESA, ESA Bulletin No. 24 Nov. 1980 p 24-27 (For primary document see N88-16755 09-12)
Copyright Avail: NTIS HC A05/MF A01

53 BEHAVIORAL SCIENCES

Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.

N88-17188# City of Hope Medical Center, Duarte, Calif. Research Inst.
LONG TERM SYNAPTIC PLASTICITY AND LEARNING IN NEURONAL NETWORKS Annual Technical Report, 15 Aug. 1986 - 14 Aug. 1987
Thomas H. Brown 14 Sep. 1987 7 p
(Contract F49620-86-C-0099)
(AD-A186834; AFOSR-87-1477TR) Avail: NTIS HC A02/MF A01 CSCL 06A

The working hypothesis has been that longterm synaptic potentiation may mediate certain of the mnemonic functions of the hippocampal circuitry. The discovery of an underlying Hebbian conjunctive mechanism has boosted confidence in this hypothesis. One major effort of the past year was to summarize and integrate this AFOSR supported discovery into a more general theoretical and experimental framework. In regard to the 4 specific aims, development of the fluctuation algorithm has been completed, and it was applied to synaptic fluctuations obtained using the loose patch clamp method (aim 2). The algorithm is currently running on a mainframe at UCLA. It is now being implemented on a small workstation (Macintosh II). As soon as it is working on the Mac II, the quantal analysis in hippocampus will begin (aim 1). The culture method is underway (aim 3) and a first-generation video microscopic technique was developed for visualizing neurons and their synapses to see if the latter move during activity (aim 4). GRA

N88-17189# Human Engineering Labs., Aberdeen Proving Ground, Md.
BRAIN POTENTIALS AND PERSONALITY: A NEW LOOK AT STRESS SUSCEPTIBILITY Final Report
Linda F. Mullins and Jeffrey H. Lukas Sep. 1987 21 p
(AD-A186931; HEL-TM-20-87) Avail: NTIS HC A03/MF A01 CSCL 06J

Today's soldier is confronted with physiological and psychological hardships that can affect the soldier's ability to function effectively and appropriately. This is seen as a breakdown of performance when sustained stress exceeds the soldier's capacity to cope. This experiment investigates an underlying constitutional factor, involving the central nervous system, that plays a role in how excitable an individual will be during any

stressful or arousing situation. Subjects listened to 1,000-Hz tone bursts ranging 40 to 85 dB sensation level (SL) in 5-dB steps in a block-randomized fashion. The brain's electrical response to the tones was averaged and collected online. The peak amplitudes were measured and the slope of the line of best fit between evoked potential amplitude and intensity was computed. Auditory augmenters have positive slopes, that is, as intensity increases so does the evoked potential amplitude. Reducers show the opposite effect. The brain potentials become smaller or reduce as intensity increases, producing a negative slope. In addition, each subject completed Zuckerman's Sensation Seeking Scale (SSS) and Vando's Reducer-Augmenter (R-A) Scale. The slope measure was significantly correlated with the experience seeking subscale of the SSS. The results indicate that auditory augmenters prefer and seek out novel and exciting experiences. And in conjunction with previous humans and animal research, the results also suggest that the augmenter may cope better with stress and high workloads. GRA

N88-17190# Dayton Univ., Ohio. Research Inst.
VISUAL ATTENTION EFFECTS ON DISCRIMINATION OF LINE ORIENTATION AND LINE ARRANGEMENT Final Technical Report, Feb. 1986 - Apr. 1987
MaryLou Cheal, Don Lyon, and David C. Hubbard Nov. 1987 34 p
(Contract F33615-84-C-0066)
(AD-A187013; AFHRL-TR-87-22) Avail: NTIS HC A03/MF A01 CSCL 05H

The distinction between visual processes that require focused attention and those that use more diffuse or global attention is largely based on studies of visual search and texture segregation. It has been inferred from these studies that stimuli differing in the orientation of their component line segments can be distinguished without focal attention, whereas stimuli that differ only in the arrangement discrimination. In the first of the present experiments, while maintaining central fixation, attention was directed to a relevant peripheral target by a cue presented in the appropriate location. Discrimination of targets that differed in orientation of lines was minimally facilitated as the time between the onset of the valid cue and the onset of the target was increased from 17 msec to 268 msec. On the other hand, discrimination of targets composed of two conjoining line segments (sideways Ts) required time to shift and focus attention, and benefits increased with longer cue-target SOAs that allowed attention to accumulate at the target. To test whether orientation discrimination would be affected by focusing attention elsewhere in the visual field, a second experiment was conducted in which a cue misdirected attention on 20% of the trials. A decrement occurred on incorrectly cued trials in comparison to correctly cued trials for both types of stimuli, SLANTs and Ts. GRA

N88-17191# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.
IMAGE CHUNKING: DEFINING SPATIAL BUILDING BLOCKS FOR SCENE ANALYSIS
James V. Mahoney Apr. 1987 186 p
(Contracts DACA76-85-C-0010; N00014-85-K-0124)
(AD-A187072; AI-TR-980) Avail: NTIS HC A09/MF A01 CSCL 05I

Rapid judgements about the properties and spatial relations of objects are the crux of visually guided interaction. Vision begins, however, with essentially pointwise representations of the scene, such as arrays of pixels or small edge fragments. For adequate time performance in recognition, manipulation, navigation, and reasoning, the processes that extract meaningful entities from the pointwise representations must exploit parallelism. A framework is developed for the fast extraction of scene entities, based on a simple, local model of parallel computation. An image chunk is a subset of an image that can act as a unit in the course of spatial analysis. A parallel preprocessing stage constructs a variety of simple chunks uniformly over the visual array. On the basis of these chunks, subsequent serial processes locate relevant scene components and assemble detailed descriptions of them rapidly. Image chunks are defined that facilitate the most potentially time-consuming operations of spatial analysis - boundary tracing, area coloring, and the selection of locations at which to apply detailed analysis. Fast parallel processes for computing these chunks from images, and chunk-based formulations of indexing, tracing and coloring, are presented. These processes have been simulated and evaluated on the LISP machine and the connection machine. GRA

N88-17192# Human Engineering Labs., Aberdeen Proving Ground, Md.
MEASURING MENTAL WORKLOAD: A PERFORMANCE BATTERY Final Report
Leslie A. Whitaker, Lynn C. Oatman, and Matthew D. Shank Sep. 1987 32 p
(AD-A187118; HEL-TM-21-87) Avail: NTIS HC A03/MF A01 CSCL 05I

A performance test battery consisting of three tasks (memory/visual search, serial arithmetic, and column addition) was developed for use on an Apple 2 microcomputer. For each task, several workload parameters were varied via a menu. In three separate experiments, performance variables (response latency and error rate) were found to be sensitive to changes in workload. THe test battery is an easy method of varying workload through the use of a controlled laboratory task. Future research measuring subjective opinions and evoked potentials is planned using this battery of tasks. GRA

N88-17193# Massachusetts Inst. of Tech., Cambridge.
VISION ALGORITHMS AND PSYCHOPHYSICS Annual Technical Report, 1 Apr. 1986 - 31 Mar. 1987
Whitman Richards 2 Oct. 1987 6 p
(Grant AF-AFOSR-0139-86)
(AD-A186773; AFOSR-87-1534TR) Avail: NTIS HC A02/MF A01 CSCL 12A

Over the past year, we have made significant progress in understanding shape perception based on curvature extrema. Through psychophysical experiments in conjunction with H.R. Wilson (Univ. of Chicago), we now are able to identify which of several computer algorithms for extracting curvature are biologically the most feasible. GRA

N88-17194# Physics and Electronics Lab. TNO, The Hague (Netherlands). Operationele Research Div.
GAVID AND ACQUIR, TWO OPERATIONS-RESEARCH (OR) MODELS FOR VISUAL DETECTION
E. Kool 20 Aug. 1985 50 p In DUTCH; ENGLISH summary
(Contract A84/KL/026)
(FEL-1985-72; ETN-87-90174) Avail: NTIS HC A03/MF A01

The principles of GAVID (Ground-to-Air Visual Detection) and ACQUIR, two OR models for visual detection, were studied. GAVID is based on tests in which a relation between the detection probability and the apparent contrast of a given object is computed. ACQUIR is based on the preciseness of the observation of bar codes with a certain size. In the calculation of the apparent stimulation of the retina by a given object in the field of view of the observer, in both models the same formula was used for the reduction of the contrast by the atmosphere. In GAVID the simulation of searching an object within a given area was divided into separated fixations; in ACQUIR the determination of detection probabilities and times is based on the mean number of fixations necessary for searching the given area one time. Author (ESA)

N88-17195# European Space Agency, Paris (France).
REFINEMENT OF EYE-POINT-OF-REGARD MEASUREMENT WITH HELICOPTER PILOTS IN A FLIGHT EXPERIMENT
Rainer Uckermann, Hans Radke, and Klaus Wendiggensen Oct. 1987 51 p Transl. into ENGLISH of Verbesserung der Blickzielerfassung bei Hubschrauberpiloten im Flugversuch (DFVLR, Brunswick, Fed. Republic of Germany), Nov. 1986 Original language document was announced as N87-29115
(ESA-TT-1073; DFVLR-FB-86-61; ETN-88-90942) Avail: NTIS

HC A04/MF A01; original German version available from DFVLR, Cologne, Fed. Republic of Germany DM 53

The NAC-4 Eye Mark Recorder was tested in flight in order to make eye-point-of-regard measurements in helicopters simple and accurate. Twelve pilots served as subjects. It was tested whether a helmet mounting of the apparatus improves the wearing quality without deteriorating the accuracy of the measurements. The results show that the helmet-mounted apparatus can be worn much better, while the quality of the measurements is as good as with the original equipment. The new configuration is especially suitable for use in long duration experiments. ESA

N88-17196# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Hamburg (West Germany). Abteilung Luft- und Raumfahrtspsychologie.

A VALIDITY STUDY OF A SELECTION PROCEDURE FOR STUDENT AIRLINE PILOTS

Hans-Juergen Hoermann and Peter Maschke Aug. 1987 67 p In GERMAN; ENGLISH summary

(DFVLR-FB-87-34; ISSN-0171-1342; ETN-88-91694) Avail: NTIS HC A04/MF A01; DFVLR, Cologne, Federal Republic of Germany, DM 19.50

Predictive validities of an aptitude test battery for student airline pilots were determined, on the basis of the two criteria: training success (pass/fail) and pilot instructor's rating. Of 4207 applicants tested, 399 persons were accepted for training ab initio, 349 of them (88 percent) were successful. Multivariate data analyses resulted in acceptable validity coefficients. Whereas tests of psychomotor coordination and multiple task performance prove to be significant predictors for training success, such characteristics as mathematical reasoning, mental concentration, perceptual speed, and spatial orientation are more related to the instructor's ratings. A cost analysis demonstrates the high utility of the selection procedure. ESA

N88-17197# European Space Agency, Paris (France).

TEMPERAMENT STRUCTURE SCALES (TSS). TEST MANUAL

Peter Maschke Nov. 1987 68 p Transl. into ENGLISH of Temperament-Struktur-Skalen (TSS). Test Manual (DFVLR, Oberpfaffenhofen, Fed. Republic of Germany), 1986 Original language document was announced as N87-26504

(ESA-TT-1069; DFVLR-FB-86-58; ETN-88-91714) Avail: NTIS HC A04/MF A01; original German version available from DFVLR, Cologne, Fed. Republic of Germany DM 23.50

A 10 dimensional personality questionnaire for the selection of aviation personnel is described. The dimensions are: motivation, emotional stability, rigidity, extraversion, aggressiveness, vitality, dominance, personal warmth, spoiledness, and mobility. ESA

N88-17198# Argonne National Lab., Ill.

PROBABILISTIC NEURAL NETWORKS: IN OR OUT OF EQUILIBRIUM

J. W. Clark 1987 11 p Presented at the 11th International Workshop on Condensed Matter Theories, Oulu, Finland, 27 Jul. 1987

(Contract W-31-109-eng-38)

(DE88-002907; CONF-8707110-3) Avail: NTIS HC A03/MF A01

The long-term behavior of neural networks following exposure to external stimuli is central to attempts at modeling brain activity and to the design of physical systems imitating biological mechanisms of memory storage and recall. A given network may exhibit many attractors, while a given attractor may correspond to a fixed point, a terminal cycle, multiperiodic motion, or chaos. If the dynamical law by which the system updates its state is probabilistic rather than deterministic, one considers an ensemble rather than a particular system. The initial preparation of the system attendant to the imposition of a temporary stimulus is reflected in the specification of an initial probability distribution (p/sub i/(0)) over microscopic system states i. Here an especially simple class of probabilistic neural network models is considered, simple in the senses that the large-t occupation probabilities are steady, implying a fixed-point attractor, and this final condition is unique, i.e. independent of initial preparation, for specified single-neuron properties and interneuronic couplings. DOE

54 MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

Includes human engineering; biotechnology; and space suits and protective clothing.

For related information see also *16 Space Transportation.*

N88-17199# Air Force Academy, Colo.

DYNAMIC FUNCTION ALLOCATION IN FIGHTER COCKPITS Final Report, Oct. 1986 - May 1987

Joseph Hickox and Susan Kegler 30 Jun. 1987 27 p

(AD-A185397; FJSRL-TR-87-0004) Avail: NTIS HC A03/MF A01 CSCL 01C

The objective of this study was to investigate alternatives for allocating the tasks associated with defensive counter measures in a fighter cockpit environment. The three methods allocated the functions either totally to the operator or a simulated expert system and dynamically at the operator's request to either. The analysis of the objective data showed there were no significant performance differences among the three treatment conditions. However, the analysis of post treatment subjective data showed the subjects did have confidence in the simulated expert system's ability to handle the threats (p less than .01) and they had a significant preference for some form of computer assistance during the missions (p less than .01). Author (GRA)

N88-17200# Air Force Human Resources Lab., Brooks AFB, Tex. Technical Services Div.

[AIR FORCE HUMAN RESOURCES LABORATORY TECHNICAL REPORTS AND TECHNICAL PAPERS] Quarterly R and D Summary, Jul. - Sep. 1987

Esther M. Barlow, ed. Oct. 1987 10 p

(AD-A186830) Avail: NTIS HC A02/MF A01 CSCL 05B

This document contains a summary of each Air Force Human Resources Laboratory Technical Report and Technical Paper that the Humans System Division Public Affairs Office has approved for public release during the past 3 months. It outlines an empirical system for assessing the impact of aptitude requirement adjustments on Air Force initial skills training; appropriateness measurement; walk-through performance testing: An innovative approach to work sample testing; job performance measurement in the military: A classification scheme, literature review, and directions for research; integrated maintenance information system: Training technology scenarios; air traffic controller trainee selection; basic attributes test (BAT) system: A preliminary evaluation; aircrew training devices: Utility and utilization of advanced instructional features; visual attention effects on discrimination of line orientation and line arrangement; training decisions system: Overview, design, and data requirements; visual contrast sensitivity functions: A comparison of two psychophysical procedures using untrained observers; how quickly can attention affect form perception, and manpower, personnel, training, and safety guidance and control for weapon system acquisitions. GRA

N88-17201# Human Engineering Labs., Aberdeen Proving Ground, Md.

COMPARISON OF ALPHANUMERIC DATA ENTRY METHODS FOR ADVANCED HELICOPTER COCKPITS Final Report

Frank J. Malkin and Kathleen A. Christ Sep. 1987 51 p

(AD-A186934; HEL-TM-17-87) Avail: NTIS HC A04/MF A01 CSCL 01C

In this study, three methods of data entry were compared for entering navigation coordinate sets: (1) connected-word voice recognition, (2) keyboard, and (3) thumb-controlled switch. The subjects, 12 active Army aviators, entered the data as a sole task and also while flying a helicopter simulator equipped with a computer-generated, external scene. The different data entry methods were compared for time to enter the data, for errors,

and for the effect on flight performance. Results showed that the keyboard was faster and resulted in fewer errors than the other two data entry methods. The time to enter data by voice was increased by the high nonrecognition rate (12 percent) and the error correction procedure. An overall 81 percent recognition accuracy rate was achieved in this study, with individual rates varying from 58 percent to 99 percent. Based on a subjective questionnaire, the majority of subjects still preferred to enter data by voice. GRA

N88-17202# Institute for Perception RVO-TNO, Soesterberg (Netherlands). Afdeling Technische Menskunde.
SITTING POSTURE OF PILOTS IN THE BOELKOW 105c HELICOPTER
D. S. C. Osinga and H. Schuffel Sep. 1986 41 p In DUTCH; ENGLISH summary
(Contract A82/KLu/113)
(IZF-1986-22; TD-86-3472; ETN-88-91306) Avail: NTIS HC A03/MF A01

Following pilots' complaints of backpain in the Boelkow 105c, sitting posture was analyzed. Position and range of controls, seat fixations, demands for outside view and view obstructions, and available cockpit space were tested against data of the static and functional anthropometry, resulting in a specification of the desired sitting posture. For the design of the cockpit geometry the existing criteria do not appear to meet the requirement. They are based on a maximum stature of 187 cm and permit a maximum stretch of shoulder and arm muscles. A comparison of the desirable sitting posture and the actual sitting posture in the 105c shows large differences. Differences cannot be compensated by modifications of the chair only. It is recommended to use the desired sitting posture as the reference in case of the specification of aircrew station geometry in helicopters, and to use mock-ups as a design tool. ESA

N88-17203# Queensland Univ., Brisbane (Australia). Dept. of Primary Industries.
FOOD IRRADIATION SEMINAR: ASIA AND THE PACIFIC
G. E. Mitchell 1986 27 p
(DE88-700432; INIS-mf-11038) Avail: NTIS (US Sales Only) HC A03/MF A01

The report covers the Seminar for Asia and the Pacific on the practical application of food irradiation. The seminar assessed the practical application of food irradiation processes, commercial utilization and international trade of irradiated food. DOE

N88-17204# Cranfield Inst. of Tech., Bedford (England). Work Organisation and Ergonomics Lab.
ERGONOMICS OF CAR CONTROLS FOR DISABLED PEOPLE, PHASE 1. PART 1: CHAPTERS 1-7. PART 2: APPENDICES. PART 3: REFERENCES
Paul Kember and Peter Staddon Mar. 1987 314 p
(Proj. TRR/842/540)
(ISBN-0-947767-82-7) Avail: NTIS HC A14/MF A01

The primary objective is to determine the values or ranges of values of forces that disabled people can exert on the primary controls of an automobile. This will lead to recommendations on desirable range of force and movement to best facilitate use by the disabled. A second objective is to determine the force and movements required to operate the primary controls on the present models of those cars likely to be purchased by disabled persons, using both data collected from car manufacturers and also data obtained from testing cars converted for use by disabled people. Apart from defining maximum force for the use of normal controls it is also intended to define acceptable limits for high-gain, low force controls. The program is structured in three phases: literature and data base searches, compilation of information from assessment centers; measurement of physical abilities of drivers including laboratory experiments; and measurement of vehicle and control system characteristic, methods of objectively defining high and low force limits, identification of gaps in knowledge. Author

N88-16644*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
HELICOPTER HUMAN FACTORS RESEARCH
David C. Nagel and Sandra G. Hart *In* NASA, Washington, NASA/Army Rotorcraft Technology. Volume 2: Materials and Structures, Propulsion and Drive Systems, Flight Dynamics and Control, and Acoustics Feb. 1988 p 929-947 (For primary document see N88-16632 09-01)
Avail: NTIS HC A25/MF A01 CSCL 05H

N88-16653*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
AN INTEGRATED APPROACH TO ROTORCRAFT HUMAN FACTORS RESEARCH
Sandra G. Hart, E. James Hartzell, James W. Voorhees, Nancy M. Bucher, and R. Jay Shively (Army Aviation Systems Command, Moffett Field, Calif.) *In* NASA, Washington, NASA/Army Rotorcraft Technology. Volume 3: Systems Integration, Research Aircraft, and Industry Feb. 1988 p 1167-1188 (For primary document see N88-16650 09-01)
Avail: NTIS HC A17/MF A01 CSCL 05H

N88-17241*# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
A SITUATION-RESPONSE MODEL FOR INTELLIGENT PILOT AIDING
Robert Schudy and Kevin Corker *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 253-259 (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 05H

N88-17242*# McDonnell Aircraft Co., St. Louis, Mo. Design Engineering-Human Factors.
A HUMAN PERFORMANCE MODELLING APPROACH TO INTELLIGENT DECISION SUPPORT SYSTEMS
Michael S. McCoy and Randy M. Boys (Texas Instruments, Inc., Dallas.) *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 261-268 (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 05H

N88-17273*# Rockwell International Corp., Downey, Calif. Space Station Systems Div.
CREW INTERFACE WITH A TELEROBOTIC CONTROL STATION
Eva Mok *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 493-496 (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 05H

N88-17280*# Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio. Air Crew Escape Group.
HYPERVELOCITY TECHNOLOGY (HVT) CREW ESCAPE
Lanny A. Jines *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 541-547 (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 05H

N88-17281*# Essex Corp., Orlando, Fla.
SURROGATE MEASURES: A PROPOSED ALTERNATIVE IN HUMAN FACTORS ASSESSMENT OF OPERATIONAL MEASURES OF PERFORMANCE
Robert S. Kennedy, Norman E. Lane, and Lois A. Kuntz *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 551-558 (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 05H

55 SPACE BIOLOGY

Includes exobiology; planetary biology; and extraterrestrial life.

N88-17205*# National Aeronautics and Space Administration, Washington, D.C.
PUBLICATIONS OF THE EXOBIOLOGY PROGRAM FOR 1986: A SPECIAL BIBLIOGRAPHY
Mar. 1988 57 p Prepared in cooperation with George Washington Univ., Washington, D.C.
(Contract NASw-3165)
(NASA-TM-4029; NAS 1.15:4029) Avail: NTIS HC A04/MF A01 CSCL 06B

A list of 1986 publications resulting from research pursued under the auspices of NASA's Exobiology Program is contained. Research supported by the program is explored in the areas of cosmic evolution of biogenic compounds, prebiotic evolution, early evolution of life, and evolution of advanced life. Premission and preproject activities supporting these areas are supported in the areas of solar system exploration and search for extraterrestrial intelligence. Author

59 MATHEMATICAL AND COMPUTER SCIENCES (GENERAL)

N88-17206*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
FIRST ANNUAL WORKSHOP ON SPACE OPERATIONS AUTOMATION AND ROBOTICS (SOAR 87)
Sandy Griffin, ed. Oct. 1987 530 p Workshop held in Houston, Tex., 5-7 Aug. 1987; sponsored by NASA, Johnson Space Flight Center and the US Air Force
(NASA-CP-2491; S-567; NAS 1.55:2491) Avail: NTIS HC A23/MF A01 CSCL 12B

Several topics relative to automation and robotics technology are discussed. Automation of checkout, ground support, and logistics; automated software development; man-machine interfaces; neural networks; systems engineering and distributed/parallel processing architectures; and artificial intelligence/expert systems are among the topics covered. For individual titles, see N88-17207 through N88-17281.

N88-17207*# Air Force Human Resources Lab., Wright-Patterson AFB, Ohio.
IMIS: INTEGRATED MAINTENANCE INFORMATION SYSTEM. A MAINTENANCE INFORMATION DELIVERY CONCEPT **c82**
Joseph C. VonHolle *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 1-9 (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 05B

The Integrated Maintenance Information System (IMIS) will optimize the use of available manpower, enhance technical performance, improve training, and reduce the support equipment and documentation needed for deployment. It will serve as the technician's single, integrated source of all the technical information required to perform modern aircraft maintenance. Author

N88-17208*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
SPACE SHUTTLE ONBOARD NAVIGATION CONSOLE EXPERT/TRAINER SYSTEM **c16**
Lui Wang and Dan Bochsler (LinCom Corp., Houston, Tex.) *In its* First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 11-14 (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 22B

A software system for use in enhancing operational performance as well as training ground controllers in monitoring onboard Space Shuttle navigation sensors is described. The Onboard Navigation (ONAV) development reflects a trend toward following a structured and methodical approach to development. The ONAV system must deal with integrated conventional and expert system software, complex interfaces, and implementation limitations due to the target operational environment. An overview of the onboard navigation sensor monitoring function is presented, along with a description of guidelines driving the development effort, requirements that the system must meet, current progress, and future efforts. Author

N88-17209*# Computer Sciences Corp., Houston, Tex. Applied Technology Div.
MPAD MCC WORKSTATION SYSTEM: ADDAM AND EEVE **c14**
Bill Kozick, Jr. and Walt Reynolds *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 15-24 (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 14B

The flight control consoles in mission control at NASA's Johnson Space Center have evolved in sophistication to the level where expert systems are now being incorporated into them as flight controller assistants. The evolution of the gateway mode, designed to obtain and redistribute numerous kinds of data provided by Mission Control computers over a laser-optical network to enable rapid prototyping development of the above application expert systems is described. This automated distribution and management system serves as an effective buffering system for assuring the necessarily separate requirements of the operational and developmental environments. Author

N88-17210*# Systems Control Technology, Inc., Palo Alto, Calif.
KNOWLEDGE BASED JET ENGINE DIAGNOSTICS **c07**
Timothy G. Jellison and Ronald L. DeHoff *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 25-30 (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 21E

A fielded expert system automates equipment fault isolation and recommends corrective maintenance action for Air Force jet engines. The knowledge based diagnostics tool was developed as an expert system interface to the Comprehensive Engine Management System, Increment IV (CEMS IV), the standard Air Force base level maintenance decision support system. XMAM (trademark), the Expert Maintenance Tool, automates procedures for troubleshooting equipment faults, provides a facility for interactive user training, and fits within a diagnostics information feedback loop to improve the troubleshooting and equipment maintenance processes. The application of expert diagnostics to the Air Force A-10A aircraft TF-34 engine equipped with the Turbine Engine Monitoring System (TEMS) is presented. Author

N88-17211*# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. Dept. of Electrical and Computer Engineering.
DEVELOPMENT OF A COMPREHENSIVE SOFTWARE ENGINEERING ENVIRONMENT **c61**
Thomas C. Hartrum and Gary B. Lamont *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 31-38 (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 09B

The generation of a set of tools for software lifecycle is a recurring theme in the software engineering literature. The development of such tools and their integration into a software development environment is a difficult task because of the magnitude (number of variables) and the complexity (combinatorics) of the software lifecycle process. An initial development of a global approach was initiated in 1982 as the Software Development Workbench (SDW). Continuing efforts focus on tool development, tool integration, human interfacing, data dictionaries, and testing algorithms. Current efforts are emphasizing natural language interfaces, expert system software development associates and

distributed environments with Ada as the target language. The current implementation of the SDW is on a VAX-11/780. Other software development tools are being networked through engineering workstations. Author

N88-17212*# Inference Corp., Los Angeles, Calif.
SIMPLIFYING THE CONSTRUCTION OF DOMAIN-SPECIFIC AUTOMATIC PROGRAMMING SYSTEMS: THE NASA AUTOMATED SOFTWARE DEVELOPMENT WORKSTATION PROJECT **c61**
Bradley P. Allen and Peter L. Holtzman *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 39-44 (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 09B

An overview is presented of the Automated Software Development Workstation Project, an effort to explore knowledge-based approaches to increasing software productivity. The project focuses on applying the concept of domain specific automatic programming systems (D-SAPSs) to application domains at NASA's Johnson Space Center. A version of a D-SAPS developed in Phase 1 of the project for the domain of space station momentum management is described. How problems encountered during its implementation led researchers to concentrate on simplifying the process of building and extending such systems is discussed. Researchers propose to do this by attacking three observed bottlenecks in the D-SAPS development process through the increased automation of the acquisition of programming knowledge and the use of an object oriented development methodology at all stages of the program design. How these ideas are being implemented in the Bauhaus, a prototype workstation for D-SAPS development is discussed. Author

N88-17213*# Rome Air Development Center, Griffiss AFB, N.Y. Command and Control Technology Div.
THE KNOWLEDGE-BASED SOFTWARE ASSISTANT **c61**
Kevin M. Benner and Douglas A. White *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 45-52 (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 09B

Where the Knowledge Based Software Assistant (KBSA) is now, four years after the initial report, is discussed. Also described is what the Rome Air Development Center expects at the end of the first contract iteration. What the second and third contract iterations will look like are characterized. Author

N88-17214*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
AN INTELLIGENT TRAINING SYSTEM FOR PAYLOAD-ASSIST MODULE DEPLOYS **c14**
R. Bowen Loftin (Houston Univ., Tex.), Lui Wang, Paul Baffes, and Monica Rua *In its* First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 53-59 (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 14B

An autonomous intelligent training system which integrates expert system technology with training/teaching methodologies is described. The Payload-Assist Module Deploys/Intelligent Computer-Aided Training (PD/ICAT) system has, so far, proven to be a potentially valuable addition to the training tools available for training Flight Dynamics Officers in shuttle ground control. The authors are convinced that the basic structure of PD/ICAT can be extended to form a general architecture for intelligent training systems for training flight controllers and crew members in the performance of complex, mission-critical tasks. Author

N88-17215*# Air Force Human Resources Lab., Wright-Patterson AFB, Ohio. Manpower and Personnel Div.
TUTORING ELECTRONIC TROUBLESHOOTING IN A SIMULATED MAINTENANCE WORK ENVIRONMENT **c14**
Sherrie P. Gott *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 61-69 (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 14B

A series of intelligent tutoring systems, or intelligent maintenance simulators, is being developed based on expert and novice problem solving data. A graded series of authentic troubleshooting problems provides the curriculum, and adaptive instructional treatments foster active learning in trainees who engage in extensive fault isolation practice and thus in conditionalizing what they know. A proof of concept training study involving human tutoring was conducted as a precursor to the computer tutors to assess this integrated, problem based approach to task analysis and instruction. Statistically significant improvements in apprentice technicians' troubleshooting efficiency were achieved after approximately six hours of training. Author

N88-17216*# Air Force Human Resources Lab., Brooks AFB, Tex.
INTELLIGENT TUTORING SYSTEMS AS TOOLS FOR INVESTIGATING INDIVIDUAL DIFFERENCES IN LEARNING **c14**
Valerie J. Shute *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 71-75 (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 14B

The ultimate goal of this research is to build an improved model-based selection and classification system for the United States Air Force. Researchers are developing innovative approaches to ability testing. The Learning Abilities Measurement Program (LAMP) examines individual differences in learning abilities, seeking answers to the questions of why some people learn more and better than others and whether there are basic cognitive processes applicable across tasks and domains that are predictive of successful performance (or whether there are more complex problem solving behaviors involved). Author

N88-17217*# North Texas State Univ., Denton. Dept. of Computer Sciences.
AN INTELLIGENT TUTOR FOR THE SPACE DOMAIN **c14**
Kathleen Swigger and Harry Loveland *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 77-83 Sponsored in part by AF (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 14B

An intelligent tutoring system for the space domain is described. This system was developed on a Xerox 1108 using LOOPS and provides an environment for discovering principles of ground tracks as a direct function of the orbital elements. Some of the more practical design and implementation issues associated with the development of intelligent tutoring systems are examined. Some solutions to the problems and some suggestions for future research are offered. Author

N88-17218*# Air Force Systems Command, Wright-Patterson AFB, Ohio.
NEURAL NETWORK BASED ARCHITECTURES FOR AEROSPACE APPLICATIONS **c63**
Richard Ricart *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 85-91 (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 09B

A brief history of the field of neural networks research is given and some simple concepts are described. In addition, some neural network based avionics research and development programs are reviewed. The need for the United States Air Force and NASA to assume a leadership role in supporting this technology is stressed. Author

N88-17219*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
DEVELOPMENT AND EXPERIMENTATION OF AN EYE/BRAIN/TASK TESTBED **c62**
Nora Harrington (Analytics, Inc., Willow Grove, Pa.) and James Villarreal *In its* First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 93-95 (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 09B

The principal objective is to develop a laboratory testbed that will provide a unique capability to elicit, control, record, and analyze the relationship of operator task loading, operator eye movement, and operator brain wave data in a computer system environment. The ramifications of an integrated eye/brain monitor to the man machine interface are staggering. The success of such a system would benefit users of space and defense, paraplegics, and the monitoring of boring screens (nuclear power plants, air defense, etc.) Author

N88-17220*# Netrologic, Inc., San Diego, Calif.
NASA JSC NEURAL NETWORK SURVEY RESULTS **c63**
Dan Greenwood *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 97-110 (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 09B

A survey of Artificial Neural Systems in support of NASA's (Johnson Space Center) Automatic Perception for Mission Planning and Flight Control Research Program was conducted. Several of the world's leading researchers contributed papers containing their most recent results on artificial neural systems. These papers were broken into categories and descriptive accounts of the results make up a large part of this report. Also included is material on sources of information on artificial neural systems such as books, technical reports, software tools, etc. Author

N88-17221*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
DESIGN OF A NEURAL NETWORK SIMULATOR ON A TRANSPUTER ARRAY **c14**
Gary McIntire (Ford Aerospace and Communications Corp., Houston, Tex.), James Villarreal, Paul Baffes, and Monica Rua *In its* First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 111-118 (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 09C

A brief summary of neural networks is presented which concentrates on the design constraints imposed. Major design issues are discussed together with analysis methods and the chosen solutions. Although the system will be capable of running on most transputer architectures, it currently is being implemented on a 40-transputer system connected to a toroidal architecture. Predictions show a performance level equivalent to that of a highly optimized simulator running on the SX-2 supercomputer. Author

N88-17222*# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio.
INTERCHANGE OF ELECTRONIC DESIGN THROUGH VHDL AND EIS **c33**
Richard M. Wallace *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 119-124 (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 22B

The need for both robust and unambiguous electronic designs is a direct requirement of the astonishing growth in design and manufacturing capability during recent years. In order to manage the plethora of designs, and have the design data both interchangeable and interoperable, the Very High Speed Integrated Circuits (VHSIC) program is developing two major standards for the electronic design community. The VHSIC Hardware Description Language (VHDL) is designed to be the lingua franca for transmission of design data between designers and their environments. The Engineering Information System (EIS) is designed to ease the integration of data betweeen diverse design automation systems. This paper describes the rationale for the necessity for these two standards and how they provide a synergistic expressive capability across the macrocosm of design environments. Author

N88-17223*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
DEVELOPMENT OF A COUPLED EXPERT SYSTEM FOR THE SPACECRAFT ATTITUDE CONTROL PROBLEM **c18**
K. Kawamura, G. Beale, J. Schaffer, B.-J. Hsieh, S. Padalkar, J. RodriguezMoscoso (Vanderbilt Univ., Nashville, Tenn.), F. Vinz, and K. Fernandez *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 125-132 (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 22B

A majority of the current expert systems focus on the symbolic-oriented logic and inference mechanisms of artificial intelligence (AI). Common rule-based systems employ empirical associations and are not well suited to deal with problems often arising in engineering. Described is a prototype expert system which combines both symbolic and numeric computing. The expert system's configuration is presented and its application to a spacecraft attitude control problem is discussed. Author

N88-17224*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
USER INTERFACE DEVICES FOR MISSION CONTROL **c14**
Wayne Boatman *In its* First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 133-134 (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 14B

The Mission Control Center (MCC) at Johnson Space Center (JSC) in Houston, Texas, is being upgraded with new technology engineering/scientific workstations. These workstations will replace the existing consoles and will emulate the present hardware input and display media. The workstations will be using new and different input devices for the flight controller to interact with the workstation and mainframes. This paper presents the results of the User Interface survey conducted by the Workstation Prototype Lab (WPL). The WPL offered the opportunity for users to do hands-on evaluations of a number of user interface options prototyped by lab personnel. Author

N88-17225*# Computer Sciences Corp., Houston, Tex. Applied Technology Div.
THE DESKTOP INTERFACE IN INTELLIGENT TUTORING SYSTEMS **c63**
Stephen Baudendistel and Grace Hua *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 135-143 (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 09B

The interface between an Intelligent Tutoring System (ITS) and the person being tutored is critical to the success of the learning process. If the interface to the ITS is confusing or non-supportive of the tutored domain, the effectiveness of the instruction will be diminished or lost entirely. Consequently, the interface to an ITS should be highly integrated with the domain to provide a robust and semantically rich learning environment. In building an ITS for ZetaLISP on a LISP Machine, a Desktop Interface was designed to support a programming learning environment. Using the bitmapped display, windows, and mouse, three desktops were designed to support self-study and tutoring of ZetaLISP. Through organization, well-defined boundaries, and domain support facilities, the desktops provide substantial flexibility and power for the student and facilitate learning ZetaLISP programming while screening the student from the complex LISP Machine environment. The student can concentrate on learning ZetaLISP programming and not on how to operate the interface or a LISP Machine. Author

N88-17226*# Battelle Columbus Labs., Ohio.
SYSTEMS INTEGRATED HUMAN ENGINEERING ON THE NAVY'S RAPID ACQUISITION OF MANUFACTURED PARTS/TEST AND INTEGRATION FACILITY **c81**
Glen R. Gallaway *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 147-152 (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 05A

Human Engineering in many projects is at best a limited support function. In this Navy project the Human Engineering function is an integral component of the systems design and development process. Human Engineering is a member of the systems design organization. This ensures that people considerations are: (1) identified early in the project; (2) accounted for in the specifications; (3) incorporated into the design; and (4) the tested product meets the needs and expectations of the people while meeting the overall systems requirements. The project exemplifies achievements that can be made by the symbiosis between systems designers, engineers and Human Engineering. This approach increases Human Engineering's effectiveness and value to a project because it becomes an accepted, contributing team member. It is an approach to doing Human Engineering that should be considered for most projects. The functional and organizational issues giving this approach strength are described. Author

N88-17227*# Softech, Inc., Fairborn, Ohio.
THE IDEAL (INTEGRATED DESIGN AND ENGINEERING ANALYSIS LANGUAGES) MODELING METHODOLOGY: CAPABILITIES AND APPLICATIONS **c61**
Ken H. Evers and Robert F. Bachert (Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio.) *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 153-158 (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 09B

The IDEAL (Integrated Design and Engineering Analysis Languages) modeling methodology has been formulated and applied over a five-year period. It has proven to be a unique, integrated approach utilizing a top-down, structured technique to define and document the system of interest; a knowledge engineering technique to collect and organize system descriptive information; a rapid prototyping technique to perform preliminary system performance analysis; and a sophisticated simulation technique to perform in-depth system performance analysis. Author

N88-17228*# Rome Air Development Center, Griffiss AFB, N.Y.
COOPERATIVE ANALYSIS EXPERT SITUATION ASSESSMENT RESEARCH **c63**
Michael G. McCown *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 161-164 (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 09B

For the past few decades, Rome Air Development Center (RADC) has been conducting research in Artificial Intelligence (AI). When the recent advances in hardware technology made many AI techniques practical, the Intelligence and Reconnaissance Directorate of RADC initiated an applications program entitled Knowledge Based Intelligence Systems (KBIS). The goal of the program is the development of a generic Intelligent Analyst System, an open machine with the framework for intelligence analysis, natural language processing, and man-machine interface techniques, needing only the specific problem domain knowledge to be operationally useful. The development of KBIS is described. Author

N88-17229*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
PERFORMANCE ANALYSIS OF PARALLEL BRANCH AND BOUND SEARCH WITH THE HYPERCUBE ARCHITECTURE **c62**
Richard T. Mraz *In its* First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 165-172 (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 09B

With the availability of commercial parallel computers, researchers are examining new classes of problems which might benefit from parallel computing. This paper presents results of an investigation of the class of search intensive problems. The specific problem discussed is the Least-Cost Branch and Bound search method of deadline job scheduling. The object-oriented design methodology was used to map the problem into a parallel solution. While the initial design was good for a prototype, the best performance resulted from fine-tuning the algorithm for a specific computer. The experiments analyze the computation time, the speed up over a VAX 11/785, and the load balance of the problem when using loosely coupled multiprocessor system based on the hypercube architecture. Author

N88-17230*# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. Dept. of Electrical and Computer Engineering.
TASK ALLOCATION IN A DISTRIBUTED COMPUTING SYSTEM **c62**
Walter D. Seward *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 173-181 (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 09B

A conceptual framework is examined for task allocation in distributed systems. Application and computing system parameters critical to task allocation decision processes are discussed. Task allocation techniques are addressed which focus on achieving a balance in the load distribution among the system's processors. Equalization of computing load among the processing elements is the goal. Examples of system performance are presented for specific applications. Both static and dynamic allocation of tasks are considered and system performance is evaluated using different task allocation methodologies. Author

N88-17231*# TRW Defense Systems Group, Redondo Beach, Calif.
USER ENGINEERING: A NEW LOOK AT SYSTEM ENGINEERING **c31**
Larry L. McLaughlin *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 183-189 (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 13B

User Engineering is a new System Engineering perspective responsible for defining and maintaining the user view of the system. Its elements are a process to guide the project and customer, a multidisciplinary team including hard and soft sciences, rapid prototyping tools to build user interfaces quickly and modify them frequently at low cost, and a prototyping center for involving users and designers in an iterative way. The main consideration is reducing the risk that the end user will not or cannot effectively use the system. The process begins with user analysis to produce cognitive and work style models, and task analysis to produce user work functions and scenarios. These become major drivers of the human computer interface design which is presented and reviewed as an interactive prototype by users. Feedback is rapid and productive, and user effectiveness can be measured and observed before the system is built and fielded. Requirements are derived via the prototype and baselined early to serve as an input to the architecture and software design. Author

N88-17232*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
APPROACHES TO THE VERIFICATION OF RULE-BASED EXPERT SYSTEMS **c63**
Chris Culbert, Gary Riley, and Robert T. Savely *In its* First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 191-196 (For primary document

see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 09B

Expert systems are a highly useful spinoff of artificial intelligence research. One major stumbling block to extended use of expert systems is the lack of well-defined verification and validation (V and V) methodologies. Since expert systems are computer programs, the definitions of verification and validation from conventional software are applicable. The primary difficulty with expert systems is the use of development methodologies which do not support effective V and V. If proper techniques are used to document requirements, V and V of rule-based expert systems is possible, and may be easier than with conventional code. For NASA applications, the flight technique panels used in previous programs should provide an excellent way to verify the rules used in expert systems. There are, however, some inherent differences in expert systems that will affect V and V considerations. Author

N88-17233*# Honeywell, Inc., Minneapolis, Minn. Systems and Research Center.
A FORMAL APPROACH TO VALIDATION AND VERIFICATION FOR KNOWLEDGE-BASED CONTROL SYSTEMS c63
Glen Castore *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 197-202 (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 09B

As control systems become more complex in response to desires for greater system flexibility, performance and reliability, the promise is held out that artificial intelligence might provide the means for building such systems. An obstacle to the use of symbolic processing constructs in this domain is the need for verification and validation (V and V) of the systems. Techniques currently in use do not seem appropriate for knowledge-based software. An outline of a formal approach to V and V for knowledge-based control systems is presented. Author

N88-17234*# Rockwell Shuttle Operations Co., Houston, Tex.
EXPERT SYSTEM VERIFICATION CONCERNS IN AN OPERATIONS ENVIRONMENT c61
Mary Ann Goodwin and Charles C. Robertson *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 203-207 (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 09B

The Space Shuttle community is currently developing a number of knowledge-based tools, primarily expert systems, to support Space Shuttle operations. It is proposed that anticipating and responding to the requirements of the operations environment will contribute to a rapid and smooth transition of expert systems from development to operations, and that the requirements for verification are critical to this transition. The paper identifies the requirements of expert systems to be used for flight planning and support and compares them to those of existing procedural software used for flight planning and support. It then explores software engineering concepts and methodology that can be used to satisfy these requirements, to aid the transition from development to operations and to support the operations environment during the lifetime of expert systems. Many of these are similar to those used for procedural hardware. Author

N88-17235*# Lockheed Missiles and Space Co., Austin, Tex. Artificial Intelligence Center.
BUILDING VALIDATION TOOLS FOR KNOWLEDGE-BASED SYSTEMS c63
R. A. Stachowitz, C. L. Chang, T. S. Stock, and J. B. Combs *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 209-216 (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 09B

The Expert Systems Validation Associate (EVA), a validation system under development at the Lockheed Artificial Intelligence Center for more than a year, provides a wide range of validation tools to check the correctness, consistency and completeness of a knowledge-based system. A declarative meta-language (higher-order language), is used to create a generic version of EVA to validate applications written in arbitrary expert system shells. The architecture and functionality of EVA are presented. The functionality includes Structure Check, Logic Check, Extended Structure Check (using semantic information), Extended Logic Check, Semantic Check, Omission Check, Rule Refinement, Control Check, Test Case Generation, Error Localization, and Behavior Verification. Author

N88-17236*# McDonnell-Douglas Astronautics Co., Houston, Tex. Engineering Services.
DIAGNOSIS: REASONING FROM FIRST PRINCIPLES AND EXPERIENTIAL KNOWLEDGE c63
Linda J. F. Williams and Dennis G. Lawler *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 217-222 (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 09B

Completeness, efficiency and autonomy are requirements for suture diagnostic reasoning systems. Methods for automating diagnostic reasoning systems include diagnosis from first principles (i.e., reasoning from a thorough description of structure and behavior) and diagnosis from experiential knowledge (i.e., reasoning from a set of examples obtained from experts). However, implementation of either as a single reasoning method fails to meet these requirements. The approach of combining reasoning from first principles and reasoning from experiential knowledge does address the requirements discussed above and can possibly ease some of the difficulties associated with knowledge acquisition by allowing developers to systematically enumerate a portion of the knowledge necessary to build the diagnosis program. The ability to enumerate knowledge systematically facilitates defining the program's scope, completeness, and competence and assists in bounding, controlling, and guiding the knowledge acquisition process. Author

N88-17237*# IBM Federal Systems Div., Houston, Texas.
VERIFYING SHUTTLE ONBOARD SOFTWARE USING EXPERT SYSTEMS c16
William B. Wingert *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 223-225 (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 22B

The Space Shuttle uses a complex set of software to guide, navigate, and control it through all phases of flight. Adding to the complexity is the fact that the software is reconfigured for each flight, i.e., thousands of constants in the software are changed to reflect the unique properties of a given mission. In the last level of tests, the software is flown through end to end nominal and abort scenarios taking the shuttle from liftoff to landing. The analysis of the results of the testing is experience and labor intensive. A set of pass/fail criteria were defined for each test case and in parallel with the knowledge acquisition, tools were developed which allowed the automation of the knowledge being gathered on paper. A prototype of the Analysis Criteria Expert System (ACES) was put into production in the verification of the reconfigured onboard flight software. Author

N88-17238*# TRW, Inc., Redondo Beach, Calif.
TEACHING ARTIFICIAL NEURAL SYSTEMS TO DRIVE: MANUAL TRAINING TECHNIQUES FOR AUTONOMOUS SYSTEMS c63
J. F. Shepanski and S. A. Macy *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 231-238 (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 09B

A methodology was developed for manually training autonomous control systems based on artificial neural systems (ANS). In applications where the rule set governing an expert's decisions is difficult to formulate, ANS can be used to extract rules by associating the information an expert receives with the actions taken. Properly constructed networks imitate rules of behavior that permits them to function autonomously when they are trained on the spanning set of possible situations. This training can be provided manually, either under the direct supervision of a system trainer, or indirectly using a background mode where the networks assimilates training data as the expert performs its day-to-day tasks. To demonstrate these methods, an ANS network was trained to drive a vehicle through simulated freeway traffic. Author

N88-17239*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

DESIGN KNOWLEDGE CAPTURE FOR THE SPACE STATION **c18**

K. R. Crouse and D. B. Wechsler (Mitre Corp., Houston, Tex.) *In its* First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 239-245 (For primary document see N88-17206 09-59)

Avail: NTIS HC A23/MF A01 CSCL 22B

The benefits of design knowledge availability are identifiable and pervasive. The implementation of design knowledge capture and storage using current technology increases the probability for success, while providing for a degree of access compatibility with future applications. The space station design definition should be expanded to include design knowledge. Design knowledge should be captured. A critical timing relationship exists between the space station development program, and the implementation of this project. Author

N88-17240*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

CONFIG: QUALITATIVE SIMULATION TOOL FOR ANALYZING BEHAVIOR OF ENGINEERING DEVICES **c38**

Jane T. Malin, Bryan D. Basham, and Richard A. Harris (Mitre Corp., Houston, Tex.) *In its* First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 247-252 (For primary document see N88-17206 09-59)

Avail: NTIS HC A23/MF A01 CSCL 14D

To design failure management expert systems, engineers mentally analyze the effects of failures and procedures as they propagate through device configurations. CONFIG is a generic device modeling tool for use in discrete event simulation, to support such analyses. CONFIG permits graphical modeling of device configurations and qualitative specification of local operating modes of device components. Computation requirements are reduced by focussing the level of component description on operating modes and failure modes, and specifying qualitative ranges of variables relative to mode transition boundaries. Simulation processing occurs only when modes change or variables cross qualitative boundaries. Device models are built graphically, using components from libraries. Components are connected at ports by graphical relations that define data flow. The core of a component model is its state transition diagram, which specifies modes of operation and transitions among them. Author

N88-17241*# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.

A SITUATION-RESPONSE MODEL FOR INTELLIGENT PILOT AIDING **c54**

Robert Schudy and Kevin Corker *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 253-259 (For primary document see N88-17206 09-59)

Avail: NTIS HC A23/MF A01 CSCL 05H

An intelligent pilot aiding system needs models of the pilot information processing to provide the computational basis for successful cooperation between the pilot and the aiding system. By combining artificial intelligence concepts with the human information processing model of Rasmussen, an abstraction hierarchy of states of knowledge, processing functions, and shortcuts are developed, which is useful for characterizing the information processing both of the pilot and of the aiding system. This approach is used in the conceptual design of a real time intelligent aiding system for flight crews of transport aircraft. One promising result was the tentative identification of a particular class of information processing shortcuts, from situation characterizations to appropriate responses, as the most important reliable pathway for dealing with complex time critical situations. Author

N88-17242*# McDonnell Aircraft Co., St. Louis, Mo. Design Engineering-Human Factors.

A HUMAN PERFORMANCE MODELLING APPROACH TO INTELLIGENT DECISION SUPPORT SYSTEMS **c54**

Michael S. McCoy and Randy M. Boys (Texas Instruments, Inc., Dallas.) *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 261-268 (For primary document see N88-17206 09-59)

Avail: NTIS HC A23/MF A01 CSCL 05H

Manned space operations require that the many automated subsystems of a space platform be controllable by a limited number of personnel. To minimize the interaction required of these operators, artificial intelligence techniques may be applied to embed a human performance model within the automated, or semi-automated, systems, thereby allowing the derivation of operator intent. A similar application has previously been proposed in the domain of fighter piloting, where the demand for pilot intent derivation is primarily a function of limited time and high workload rather than limited operators. The derivation and propagation of pilot intent is presented as it might be applied to some programs. Author

N88-17243*# McDonnell-Douglas Astronautics Co., St. Louis, Mo.

THE EMPIRICAL ACCURACY OF UNCERTAIN INFERENCE MODELS **c63**

David S. Vaughan, Robert M. Yadrick, Bruce M. Perrin, and Ben P. Wise (Dartmouth Coll., Hanover, N.H.) *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 269-275 (For primary document see N88-17206 09-59)

Avail: NTIS HC A23/MF A01 CSCL 09B

Uncertainty is a pervasive feature of the domains in which expert systems are designed to function. Research design to test uncertain inference methods for accuracy and robustness, in accordance with standard engineering practice is reviewed. Several studies were conducted to assess how well various methods perform on problems constructed so that correct answers are known, and to find out what underlying features of a problem cause strong or weak performance. For each method studied, situations were identified in which performance deteriorates dramatically. Over a broad range of problems, some well known methods do only about as well as a simple linear regression model, and often much worse than a simple independence probability model. The results indicate that some commercially available expert system shells should be used with caution, because the uncertain inference models that they implement can yield rather inaccurate results. Author

N88-17244*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

AUTONOMOUS CONTROL PROCEDURES FOR SHUTTLE RENDEZVOUS PROXIMITY OPERATIONS **c16**

Robert N. Lea, Eric V. Mitchell, and Mary Ann Goodwin (Rockwell Shuttle Operations Co., Houston, Tex.) *In its* First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 281-286 (For primary document see N88-17206 09-59)

Avail: NTIS HC A23/MF A01 CSCL 22B

The results are presented of a study which uses fuzzy sets to model a Space Shuttle pilot's reasoning and actions while

performing rendezvous proximity operation maneuvers. In this model fuzzy sets are used to simulate smooth and continuous actions as would be expected from an experienced pilot and to simulate common sense reasoning in the decision process. The present model assumes visual information available to the Shuttle pilot from the Shuttle Crew Optical Alignment Sighting (COAS) device and the overhead window and rendezvous radar sensor information available to him from an onboard display. This model will be used in a flight analysis simulator to perform studies requiring a large number of runs, each of which currently needs an engineer in the loop to supply the piloting decisions. This work has much broader implications in control of robots such as the Flight Telerobotic Servicer, in automated pilot control and attitude control, and in advisory and evaluation functions that could be used for flight data monitoring or for testing of various rule sets in flight preparation. Author

N88-17245*# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. Dept. of Operational Sciences.
ARTIFICIAL INTELLIGENCE (AI), OPERATIONS RESEARCH (OR), AND DECISION SUPPORT SYSTEMS (DSS): A CONCEPTUAL FRAMEWORK **c63**
Gregory S. Parnell, William F. Rowell, and John R. Valusek *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 287-292 (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 09B

In recent years there has been increasing interest in applying the computer based problem solving techniques of Artificial Intelligence (AI), Operations Research (OR), and Decision Support Systems (DSS) to analyze extremely complex problems. A conceptual framework is developed for successfully integrating these three techniques. First, the fields of AI, OR, and DSS are defined and the relationships among the three fields are explored. Next, a comprehensive adaptive design methodology for AI and OR modeling within the context of a DSS is described. These observations are made: (1) the solution of extremely complex knowledge problems with ill-defined, changing requirements can benefit greatly from the use of the adaptive design process, (2) the field of DSS provides the focus on the decision making process essential for tailoring solutions to these complex problems, (3) the characteristics of AI, OR, and DSS tools appears to be converging rapidly, and (4) there is a growing need for an interdisciplinary AI/OR/DSS education. Author

N88-17246*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
ROBOTIC PLANNER EXPERT SYSTEM (RPLANES) **c63**
Ervin ONeal Grice *In its* First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 293-297 (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 09B

The Artificial Intelligence Section of the Mission Planning and Analysis of the Johnson Space Center has developed a prototype of an expert system for robotic planning. A robot is given a high level goal to perform an action (i.e., swap, adjust, or stow) on a component unit of an object such as a satellite and the Robotic Planner Expert System (RPLANES) generates the necessary goals for arm actions. RPLANES is designed using the Inference Corp. Automated Reasoning Tool (ART) development tool. It resides on a SYMBOLICS 3670. RPLANES and its evolution are described. Author

N88-17247*# National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.
EXPERT MISSION PLANNING AND REPLANNING SCHEDULING SYSTEM FOR NASA KSC PAYLOAD OPERATIONS **c16**
Roger Pierce *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 299-306 (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 22B

EMPRESS (Expert Mission Planning and REplanning Scheduling System) is an expert system created to assist payload mission planners at Kennedy in the long range planning and scheduling of horizontal payloads for space shuttle flights. Using the current flight manifest, these planners develop mission and payload schedules detailing all processing to be performed in the Operations and Checkout building at Kennedy. With the EMPRESS system, schedules are generated quickly using standard flows that represent the tasks and resources required to process a specific horizontal carrier. Resources can be tracked and resource conflicts can be determined and resolved interactively. Constraint relationships between tasks are maintained and can be enforced when a task is moved or rescheduled. The domain, structure, and functionality of the EMPRESS system is briefly designed. The limitations of the EMPRESS system are described as well as improvements expected with the EMPRESS-2 development. Author

N88-17248*# Mitre Corp., Bedford, Mass.
TRIMODAL INTERPRETATION OF CONSTRAINTS FOR PLANNING **c61**
David Krieger and Richard Brown *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 307-313 Sponsored in part by NASA. Kennedy Space Center, and by Air Force (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 22B

Constraints are used in the CAMPS knowledge based planning system to represent those propositions that must be true for a plan to be acceptable. CAMPS introduces the make-mode for interpreting a constraint. Given an unsatisfied constraint, make evaluation mode suggests planning actions which, if taken, would result in a modified plan in which the constraint in question may be satisfied. These suggested planning actions, termed delta-tuples, are the raw material of intelligent plan repair. They are used both in debugging an almost-right plan and in replanning due to changing situations. Given a defective plan in which some set of constraints are violated, a problem solving strategy selects one or more constraints as a focus of attention. These selected constraints are evaluated in the make-mode to produce delta-tuples. The problem solving strategy then reviews the delta-tuples according to its application and problem-specific criteria to find the most acceptable change in terms of success likelihood and plan disruption. Finally, the problem solving strategy makes the suggested alteration to the plan and then rechecks constraints to find any unexpected consequences. Author

N88-17249*# IBM Federal Systems Div., Gaithersburg, Md.
RANGE AND MISSION SCHEDULING AUTOMATION USING COMBINED AI AND OPERATIONS RESEARCH TECHNIQUES **c81**
Mansur Arbabi and Michael Pfeifer *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 315-320 (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 05A

Ground-based systems for Satellite Command, Control, and Communications (C3) operations require a method for planning, scheduling and assigning the range resources such as: antenna systems scattered around the world, communications systems, and personnel. The method must accommodate user priorities, last minute changes, maintenance requirements, and exceptions from nominal requirements. Described are computer programs which solve 24 hour scheduling problems, using heuristic algorithms and a real time interactive scheduling process. Author

N88-17250*# Rome Air Development Center, Griffiss AFB, N.Y.
ADVANCED DECISION AIDING TECHNIQUES APPLICABLE TO SPACE **c63**
Robert J. Kruchten *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 321-326 (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 09B

RADC has had an intensive program to show the feasibility of applying advanced technology to Air Force decision aiding situations. Some aspects of the program, such as Satellite Autonomy, are directly applicable to space systems. For example, RADC has shown the feasibility of decision aids that combine the advantages of laser disks and computer generated graphics; decision aids that interface object-oriented programs with expert systems; decision aids that solve path optimization problems; etc. Some of the key techniques that could be used in space applications are reviewed. Current applications are reviewed along with their advantages and disadvantages, and examples are given of possible space applications. The emphasis is to share RADC experience in decision aiding techniques. Author

N88-17251*# Systems Control Technology, Inc., Palo Alto, Calif.

AUTOMATIC ROUTING MODULE **c63**

Janice A. Malin *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 327-334 (For primary document see N88-17206 09-59)

Avail: NTIS HC A23/MF A01 CSCL 09B

Automatic Routing Module (ARM) is a tool to partially automate Air Launched Cruise Missile (ALCM) routing. For any accessible launch point or target pair, ARM creates flyable routes that, within the fidelity of the models, are optimal in terms of threat avoidance, clobber avoidance, and adherence to vehicle and planning constraints. Although highly algorithmic, ARM is an expert system. Because of the heuristics applied, ARM generated routes closely resemble manually generated routes in routine cases. In more complex cases, ARM's ability to accumulate and assess threat danger in three dimensions and trade that danger off with the probability of ground clobber results in the safest path around or through difficult areas. The tools available prior to ARM did not provide the planner with enough information or present it in such a way that ensured he would select the safest path. Author

N88-17252*# Texas Instruments, Inc., Dallas.

ROBOTIC AIR VEHICLE. BLENDING ARTIFICIAL INTELLIGENCE WITH CONVENTIONAL SOFTWARE **c05**

Christa McNulty, Joyce Graham, and Paul Roewer *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 335-340 (For primary document see N88-17206 09-59)

Avail: NTIS HC A23/MF A01 CSCL 01C

The Robotic Air Vehicle (RAV) system is described. The program's objectives were to design, implement, and demonstrate cooperating expert systems for piloting robotic air vehicles. The development of this system merges conventional programming used in passive navigation with Artificial Intelligence techniques such as voice recognition, spatial reasoning, and expert systems. The individual components of the RAV system are discussed as well as their interactions with each other and how they operate as a system. Author

N88-17253*# Systems Research and Applications, Inc., Arlington, Va.

SWAN: AN EXPERT SYSTEM WITH NATURAL LANGUAGE INTERFACE FOR TACTICAL AIR CAPABILITY ASSESSMENT **c61**

Robert M. Simmons *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 341-348 (For primary document see N88-17206 09-59)

Avail: NTIS HC A23/MF A01 CSCL 09B

SWAN is an expert system and natural language interface for assessing the war fighting capability of Air Force units in Europe. The expert system is an object oriented knowledge based simulation with an alternate worlds facility for performing what-if excursions. Responses from the system take the form of generated text, tables, or graphs. The natural language interface is an expert system in its own right, with a knowledge base and rules which understand how to access external databases, models, or expert systems. The distinguishing feature of the Air Force expert system is its use of meta-knowledge to generate explanations in the frame and procedure based environment. Author

N88-17254*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

EXPERT SYSTEM APPLICATIONS IN SPACECRAFT SUBSYSTEM CONTROLLERS **c18**

Paul F. Marshall *In its* First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 349-353 (For primary document see N88-17206 09-59)

Avail: NTIS HC A23/MF A01 CSCL 22B

As NASA progresses into the development phase of the space station, it recognizes the importance and potential payback of high autonomous spacecraft subsystems. Priorities are presented for embedded expert system enhancements to the automatic control systems of the space station thermal, EVA, and life support systems. The primary emphasis is on top level application areas and development concerns for expert systems. Author

N88-17255*# National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.

THE KATE SHELL: AN IMPLEMENTATION OF MODEL-BASED CONTROL, MONITOR AND DIAGNOSIS **c61**

Matthew Cornell *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 355-360 (For primary document see N88-17206 09-59)

Avail: NTIS HC A23/MF A01 CSCL 09B

The conventional control and monitor software currently used by the Space Center for Space Shuttle processing has many limitations such as high maintenance costs, limited diagnostic capabilities and simulation support. These limitations have caused the development of a knowledge based (or model based) shell to generically control and monitor electro-mechanical systems. The knowledge base describes the system's structure and function and is used by a software shell to do real time constraints checking, low level control of components, diagnosis of detected faults, sensor validation, automatic generation of schematic diagrams and automatic recovery from failures. This approach is more versatile and more powerful than the conventional hard coded approach and offers many advantages over it, although, for systems which require high speed reaction times or aren't well understood, knowledge based control and monitor systems may not be appropriate. Author

N88-17256*# Ford Aerospace and Communications Corp., Sunnyvale, Calif.

BEYOND RULES: THE NEXT GENERATION OF EXPERT SYSTEMS **c63**

Jay C. Ferguson and Robert E. Wagner *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 363-369 (For primary document see N88-17206 09-59)

Avail: NTIS HC A23/MF A01 CSCL 09B

The PARAGON Representation, Management, and Manipulation system is introduced. The concepts of knowledge representation, knowledge management, and knowledge manipulation are combined in a comprehensive system for solving real world problems requiring high levels of expertise in a real time environment. In most applications the complexity of the problem and the representation used to describe the domain knowledge tend to obscure the information from which solutions are derived. This inhibits the acquisition of domain knowledge verification/validation, places severe constraints on the ability to extend and maintain a knowledge base while making generic problem solving strategies difficult to develop. A unique hybrid system was developed to overcome these traditional limitations. Author

N88-17257*# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.

A CONCEPTUAL FRAMEWORK FOR INTELLIGENT REAL-TIME INFORMATION PROCESSING **c63**

Robert Schudy *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 371-374 (For primary document see N88-17206 09-59)

Avail: NTIS HC A23/MF A01 CSCL 09B

By combining artificial intelligence concepts with the human information processing model of Rasmussen, a conceptual framework was developed for real time artificial intelligence systems which provides a foundation for system organization, control and validation. The approach is based on the description of system processing terms of an abstraction hierarchy of states of knowledge. The states of knowledge are organized along one dimension which corresponds to the extent to which the concepts are expressed in terms of the system inouts or in terms of the system response. Thus organized, the useful states form a generally triangular shape with the sensors and effectors forming the lower two vertices and the full evaluated set of courses of action the apex. Within the triangle boundaries are numerous processing paths which shortcut the detailed processing, by connecting incomplete levels of analysis to partially defined responses. Shortcuts at different levels of abstraction include reflexes, sensory motor control, rule based behavior, and satisficing. This approach was used in the design of a real time tactical decision aiding system, and in defining an intelligent aiding system for transport pilots.

Author

N88-17258*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

TDAS: THE THERMAL EXPERT SYSTEM (TEXSYS) DATA ACQUISITION SYSTEM **c63**

Edmund C. Hack (Lockheed Engineering and Management Services Co., Inc., Houston, Tex.) and Kathleen J. Healey *In its* First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 375-382 (For primary document see N88-17206 09-59)

Avail: NTIS HC A23/MF A01 CSCL 09B

As part of the NASA Systems Autonomy Demonstration Project, a thermal expert system (TEXSYS) is being developed. TEXSYS combines a fast real time control system, a sophisticated human interface for the user and several distinct artificial intelligence techniques in one system. TEXSYS is to provide real time control, operations advice and fault detection, isolation and recovery capabilities for the space station Thermal Test Bed (TTB). TEXSYS will be integrated with the TTB and act as an intelligent assistant to thermal engineers conducting TTB tests and experiments. The results are presented from connecting the real time controller to the knowledge based system thereby creating an integrated system. Special attention will be paid to the problem of filtering and interpreting the raw, real time data and placing the important values into the knowledge base of the expert system. Author

N88-17259*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

IMPLEMENTING CLIPS ON A PARALLEL COMPUTER **c62**

Gary Riley *In its* First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 383-387 (For primary document see N88-17206 09-59)

Avail: NTIS HC A23/MF A01 CSCL 09B

The C language integrated production system (CLIPS) is a forward chaining rule based language to provide training and delivery for expert systems. Conceptually, rule based languages have great potential for benefiting from the inherent parallelism of the algorithms that they employ. During each cycle of execution, a knowledge base of information is compared against a set of rules to determine if any rules are applicable. Parallelism also can be employed for use with multiple cooperating expert systems. To investigate the potential benefits of using a parallel computer to speed up the comparison of facts to rules in expert systems, a parallel version of CLIPS was developed for the FLEX/32, a large grain parallel computer. The FLEX implementation takes a macroscopic approach in achieving parallelism by splitting whole sets of rules among several processors rather than by splitting the components of an individual rule among processors. The parallel CLIPS prototype demonstrates the potential advantages of integrating expert system tools with parallel computers.

Author

N88-17260*# Worcester Polytechnic Inst., Mass. Intelligent Machines Group.

REAL-TIME ARTIFICIAL INTELLIGENCE ISSUES IN THE DEVELOPMENT OF THE ADAPTIVE TACTICAL NAVIGATOR **c63**

Peter E. Green, Douglas P. Glasson, Jean-Michel L. Pomarede, and Narayan A. Acharya (Analytic Sciences Corp., Reading, Mass.) *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 389-396 (For primary document see N88-17206 09-59)

Avail: NTIS HC A23/MF A01 CSCL 09B

Adaptive Tactical Navigation (ATN) is a laboratory prototype of a knowledge based system to provide navigation system management and decision aiding in the next generation of tactical aircraft. ATN's purpose is to manage a set of multimode navigation equipment, dynamically selecting the best equipment to use in accordance with mission goals and phase, threat environment, equipment malfunction status, and battle damage. ATN encompasses functions as diverse as sensor data interpretation, diagnosis, and planning. Real time issues that were identified in ATN and the approaches used to address them are addressed. Functional requirements and a global architecture for the ATN system are described. Decision making with time constraints are discussed. Two subproblems are identified; making decisions with incomplete information and with limited resources. Approaches used in ATN to address real time performance are described and simulation results are discussed. Author

N88-17261*# Michigan Univ., Ann Arbor. Robotics Research Lab.

SOFTWARE FOR INTEGRATED MANUFACTURING SYSTEMS, PART 1 **c61**

A. W. Naylor and R. A. Volz *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 397-398 (For primary document see N88-17206 09-59)

Avail: NTIS HC A23/MF A01 CSCL 09B

For several years, a broad, unified approach to programming manufacturing cells, factory floors, and other manufacturing systems has been developed. It is based on a blending of distributed Ada, software components, generics and formal models. Among other things the machines and devices which make up the components, and the entire manufacturing cell is viewed as an assembly of software components. The purpose of this project is to reduce cost, increase the reliability and increase the flexibility of manufacturing software. An overview is given of the approach and an experimental generic factory floor controller that was developed using the approach is described. The controller is generic in the sense that it can control any one of a large class of factory floors making an arbitrary mix of parts. Author

N88-17262*# Michigan Univ., Ann Arbor. Robotics Research Lab.

SOFTWARE FOR INTEGRATED MANUFACTURING SYSTEMS, PART 2 **c61**

R. A. Volz and A. W. Naylor *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 399-403 (For primary document see N88-17206 09-59)

Avail: NTIS HC A23/MF A01 CSCL 09B

Part 1 presented an overview of the unified approach to manufacturing software. The specific characteristics of the approach that allow it to realize the goals of reduced cost, increased reliability and increased flexibility are considered. Why the blending

of a components view, distributed languages, generics and formal models is important, why each individual part of this approach is essential, and why each component will typically have each of these parts are examined. An example of a specification for a real material handling system is presented using the approach and compared with the standard interface specification given by the manufacturer. Use of the component in a distributed manufacturing system is then compared with use of the traditional specification with a more traditional approach to designing the system. An overview is also provided of the underlying mechanisms used for implementing distributed manufacturing systems using the unified software/hardware component approach. Author

N88-17263*# Michigan Univ., Ann Arbor. Real-Time Computing Lab.

COMMUNICATION AND CONTROL IN AN INTEGRATED MANUFACTURING SYSTEM **c61**

Kang G. Shin, Robert D. Throne, and Yogesh K. Muthuswamy *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 405-411 (For primary document see N88-17206 09-59)

(Contracts NCC-9-16; F33615-85-C-5105)

Avail: NTIS HC A23/MF A01 CSCL 09B

Typically, components in a manufacturing system are all centrally controlled. Due to possible communication bottlenecking, unreliability, and inflexibility caused by using a centralized controller, a new concept of system integration called an Integrated Multi-Robot System (IMRS) was developed. The IMRS can be viewed as a distributed real time system. Some of the current research issues being examined to extend the framework of the IMRS to meet its performance goals are presented. These issues include the use of communication coprocessors to enhance performance, the distribution of tasks and the methods of providing fault tolerance in the IMRS. An application example of real time collision detection, as it relates to the IMRS concept, is also presented and discussed. Author

N88-17264*# Industrial Technology Inst., Ann Arbor, Mich.

DEVELOPMENT OF MOIRE MACHINE VISION **c74**

Kevin G. Harding *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 413-419 (For primary document see N88-17206 09-59)

Avail: NTIS HC A23/MF A01 CSCL 20F

Three dimensional perception is essential to the development of versatile robotics systems in order to handle complex manufacturing tasks in future factories and in providing high accuracy measurements needed in flexible manufacturing and quality control. A program is described which will develop the potential of Moire techniques to provide this capability in vision systems and automated measurements, and demonstrate artificial intelligence (AI) techniques to take advantage of the strengths of Moire sensing. Moire techniques provide a means of optically manipulating the complex visual data in a three dimensional scene into a form which can be easily and quickly analyzed by computers. This type of optical data manipulation provides high productivity through integrated automation, producing a high quality product while reducing computer and mechanical manipulation requirements and thereby the cost and time of production. This nondestructive evaluation is developed to be able to make full field range measurement and three dimensional scene analysis. Author

N88-17265*# Honeywell, Inc., Golden Valley, Minn. Corporate Systems Development Div.

IMPLEMENTATION OF A ROBOTIC FLEXIBLE ASSEMBLY SYSTEM **c37**

Ronald C. Benton *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 421-429 (For primary document see N88-17206 09-59)

Avail: NTIS HC A23/MF A01 CSCL 13I

As part of the Intelligent Task Automation program, a team developed enabling technologies for programmable, sensory controlled manipulation in unstructured environments. These technologies include 2-D/3-D vision sensing and understanding, force sensing and high speed force control, 2.5-D vision alignment and control, and multiple processor architectures. The subsequent design of a flexible, programmable, sensor controlled robotic assembly system for small electromechanical devices is described using these technologies and ongoing implementation and integration efforts. Using vision, the system picks parts dumped randomly in a tray. Using vision and force control, it performs high speed part mating, in-process monitoring/verification of expected results and autonomous recovery from some errors. It is programmed off line with semiautomatic action planning. Author

N88-17266*# SRI International Corp., Menlo Park, Calif. Robotics Lab.

SYSTEM INTEGRATION OF A TELEROBOTIC DEMONSTRATION SYSTEM (TDS) TESTBED **c37**

John K. Myers *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 433-440 (For primary document see N88-17206 09-59)

(Contract JPL-957908)

Avail: NTIS HC A23/MF A01 CSCL 13I

The concept for and status of a telerobotic demonstration system testbed that integrates teleoperation and robotics is described. The components of the telerobotic system are described and the ongoing projects are discussed. The system can be divided into two sections: the autonomous subsystems, and the additional interface and support subsystems including teleoperations. The workings of each subsystem by itself and how the subsystems integrate into a complete system is discussed. Author

N88-17267*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

VISION TECHNOLOGY/ALGORITHMS FOR SPACE ROBOTICS APPLICATIONS **c37**

Kumar Krishen and Rui J. P. deFigueiredo (Rice Univ., Houston, Tex.) *In its* First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 441-453 (For primary document see N88-17206 09-59)

Avail: NTIS HC A23/MF A01 CSCL 13I

The thrust of automation and robotics for space applications has been proposed for increased productivity, improved reliability, increased flexibility, higher safety, and for the performance of automating time-consuming tasks, increasing productivity/performance of crew-accomplished tasks, and performing tasks beyond the capability of the crew. This paper provides a review of efforts currently in progress in the area of robotic vision. Both systems and algorithms are discussed. the evolution of future vision/sensing is projected to include the fusion of multisensors ranging from microwave to optical with multimode capability to include position, attitude, recognition, and motion parameters. The key feature of the overall system design will be small size and weight, fast signal processing, robust algorithms, and acccurate parameter determination. These aspects of vision/sensing are also discussed. Author

N88-17268*# McDonnell-Douglas Astronautics Co., Houston, Tex. Engineering Services.

AN OPTIMAL RESOLVED RATE LAW FOR KINEMATICALLY REDUNDANT MANIPULATORS **c37**

B. J. Bourgeois *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 457-464 (For primary document see N88-17206 09-59)

Avail: NTIS HC A23/MF A01 CSCL 13I

The resolved rate law for a manipulator provides the instantaneous joint rates required to satisfy a given instantaneous hand motion. When the joint space has more degrees of freedom than the task space, the manipulator is kinematically redundant

and the kinematic rate equations are underdetermined. These equations can be locally optimized, but the resulting pseudo-inverse solution has been found to cause large joint rates in some cases. A weighting matrix in the locally optimized (pseudo-inverse) solution is dynamically adjusted to control the joint motion as desired. Joint reach limit avoidance is demonstrated in a kinematically redundant planar arm model. The treatment is applicable to redundant manipulators with any number of revolute joints and to non-planar manipulators. Author

N88-17269*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
TELEROBOTIC RESEARCH AT NASA LANGLEY RESEARCH CENTER c37
Nancy E. Sliwa *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 465-469 (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 13I

An overview of Automation Technology Branch facilities and research is presented. Manipulator research includes dual-arm coordination studies, space manipulator dynamics, end-effector controller development, automatic space structure assembly, and the development of a dual-arm master-slave telerobotic manipulator system. Sensór research includes gravity-compensated force control, real-time monovision techniques, and laser ranging. Artificial intelligence techniques are being explored for supervisory task control, collision avoidance, and connectionist system architectures. A high-fidelity dynamic simulation of robotic systems, ROBSIM, is being supported and extended. Cooperative efforts with Oak Ridge National Laboratory have verified the ability of teleoperators to perform complex structural assembly tasks, and have resulted in the definition of a new dual-arm master-slave telerobotic manipulator. A bibliography of research results and a list of technical contacts are included. Author

N88-17270*# Rockwell International Corp., Downey, Calif. Space Station Systems Div.
MANIPULATOR ARM DESIGN FOR THE EXTRAVEHICULAR TELEOPERATOR ASSIST ROBOT (ETAR): APPLICATIONS ON THE SPACE STATION c37
Margaret M. Clarke, Charles J. Divona, and William M. Thompson (NSA Electro-Mechanidcal Systems Div., Breta, Calif.) *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 471-475 (For primary document see N88-17206 09-59)
(Contract NAS8-36629)
Avail: NTIS HC A23/MF A01 CSCL 13I

The preliminary conceptual design of a new teleoperator robot manipulator system for space station maintenance missions has been completed. The system consists of a unique pair of arms that is part of a master-slave, force-reflecting servomanipulator. This design allows greater dexterity and greater volume coverage than that available in current designs and concepts. The teleoperator manipulator is specifically designed for space applications and is a valuable extension of the current state-of-the-art earthbound manipulators marketed today. The manipulator and its potential application on the space station are described. Author

N88-17271*# Central Inertial Guidance Test Facility, Holloman AFB, N.Mex.
DEVELOPMENT OF A FACILITY USING ROBOTICS FOR TESTING AUTOMATION OF INERTIAL INSTRUMENTS c14
Joy Y. Greig, Gary B. Lamont, Daniel J. Biezad, and Zdsislaw H. Lewantowicz (Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.) *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 477-483 (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 14B

The Integrated Robotics System Simulation (ROBSIM) was used to evaluate the performance of the PUMA 560 arm as applied to testing of inertial sensors. Results of this effort were used in the design and development of a feasibility test environment using a PUMA 560 arm. The implemented facility demonstrated the ability to perform conventional static inertial instrument tests (rotation and tumble). The facility included an efficient data acquisitions capability along with a precision test servomechanism function resulting in various data presentations which are included in the paper. Analysis of inertial instrument testing accuracy, repeatability and noise characteristics are provided for the PUMA 560 as well as for other possible commercial arm configurations. Another integral aspect of the effort was an in-depth economic analysis and comparison of robot arm testing versus use of contemporary precision test equipment. Author

N88-17272*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
TELEROBOTIC TRUSS ASSEMBLY c37
Philip L. Sheridan *In its* First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 487-491 (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 13I

The ACCESS truss was telerobotically assembled in order to gain experience with robotic assembly of hardware designed for astronaut extravehicular (EVA) assembly. Tight alignment constraints of the ACCESS hardware made telerobotic assembly difficult. A wider alignment envelope and a compliant end effector would have reduced the problem. The manipulator had no linear motion capability, but many of the assembly operations required straight line motion. The manipulator was attached to a motion table in order to provide the X, Y, and Z translations needed. A programmable robot with linear translation capability would have eliminated the need for the motion table and streamlined the assembly. Poor depth perception was a major problem. Shaded paint schemes and alignment lines were helpful in reducing this problem. The four cameras used worked well for only some operations. It was not possible to identify camera locations that worked well for all assembly steps. More cameras or movable cameras would have simplified some operations. The audio feedback system was useful. Author

N88-17273*# Rockwell International Corp., Downey, Calif. Space Station Systems Div.
CREW INTERFACE WITH A TELEROBOTIC CONTROL STATION c54
Eva Mok *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 493-496 (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 05H

A method for apportioning crew-telerobot tasks has been derived to facilitate the design of a crew-friendly telerobot control station. To identify the most appropriate state-of-the-art hardware for the control station, task apportionment must first be conducted to identify if an astronaut or a telerobot is best to execute the task and which displays and controls are required for monitoring and performance. Basic steps that comprise the task analysis process are: (1) identify space station tasks; (2) define tasks; (3) define task performance criteria and perform task apportionment; (4) verify task apportionment; (5) generate control station requirements; (6) develop design concepts to meet requirements; and (7) test and verify design concepts. Author

N88-17274*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
TELEROBOT FOR SPACE STATION c37
Lyle M. Jenkins *In its* First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 497-499 (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 13I

The Flight Telerobotic Servicer (FTS), a multiple arm dexterous manipulation system, will aid in the assembly, maintenance, and

servicing of the space station. Fundamental ideas and basic conceptual designs for a shuttle-based telerobot system have been produced. Recent space station studies provide additional concepts that should aid in the accomplishment of mission requirements. Currently, the FTS is in contractual source selection for a Phase B preliminary design. At the same time, design requirements are being developed through a series of robotic assessment tasks being performed at NASA and commercial installations. A number of the requirements for remote operation on the space station, necessary to supplement extravehicular activity (EVA), will be met by the FTS. Finally, technology developed for telerobotics will advance the state of the art of remote operating systems, enhance operator productivity, and prove instrumental in the evolution of an adaptive, intelligent autonomous robot. Author

N88-17275*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
THE USE OF COMPUTER GRAPHIC SIMULATION IN THE DEVELOPMENT OF ROBOTIC SYSTEMS c61
Ken Fernandez *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas. First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 501-511 Previously announced in IAA as A87-15812 (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 09B

This paper describes the use of computer graphic simulation techniques to resolve critical design and operational issues for robotic systems. Use of this technology will result in greatly improved systems and reduced development costs. The major design issues in developing effective robotic systems are discussed and the use of ROBOSIM, a NASA developed simulation tool, to address these issues is presented. Three representative simulation case studies are reviewed: off-line programming of the robotic welding development cell for the Space Shuttle Main Engine (SSME); the integration of a sensor to control the robot used for removing the Thermal Protection System (TPS) from the Solid Rocket Booster (SRB); and the development of a teleoperator/robot mechanism for the Orbital Maneuvering Vehicle (OMV). Author

N88-17276*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
INTELLIGENT ROBOTIC TRACKER c37
W. S. Otaguro, L. O. Kesler (McDonnell-Douglas Astronautics Co., Huntington Beach, Calif.), K. C. Land, and D. E. Rhoades *In its* First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 513-517 (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 13I

An intelligent tracker capable of robotic applications requiring guidance and control of platforms, robotic arms, and end effectors has been developed. This packaged system capable of supervised autonomous robotic functions is partitioned into a multiple processor/parallel processing configuration. The system currently interfaces to cameras but has the capability to also use three-dimensional inputs from scanning laser rangers. The inputs are fed into an image processing and tracking section where the camera inputs are conditioned for the multiple tracker algorithms. An executive section monitors the image processing and tracker outputs and performs all the control and decision processes. The present architecture of the system is presented with discussion of its evolutionary growth for space applications. An autonomous rendezvous demonstration of this system was performed last year. More realistic demonstrations in planning are discussed. Author

N88-17277*# California Univ., Santa Barbara. Dept. of Computer Science.
CALIBRATION OF NEURAL NETWORKS USING GENETIC ALGORITHMS, WITH APPLICATION TO OPTIMAL PATH PLANNING c62
Terence R. Smith, Gilbert A. Pitney, and Daniel Greenwood (Netrologic, Inc., San Diego, Calif.) *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 519-531 (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 09B

Genetic algorithms (GA) are used to search the synaptic weight space of artificial neural systems (ANS) for weight vectors that optimize some network performance function. GAs do not suffer from some of the architectural constraints involved with other techniques and it is straightforward to incorporate terms into the performance function concerning the metastructure of the ANS. Hence GAs offer a remarkably general approach to calibrating ANS. GAs are applied to the problem of calibrating an ANS that finds optimal paths over a given surface. This problem involves training an ANS on a relatively small set of paths and then examining whether the calibrated ANS is able to find good paths between arbitrary start and end points on the surface. Author

N88-17278*# Texas Instruments, Inc., Dallas. Corporate Artificial Intelligence Lab.
AN EFFICIENT REPRESENTATION OF SPATIAL INFORMATION FOR EXPERT REASONING IN ROBOTIC VEHICLES c63
Steven Scott and Mark Interrante *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 527-531 (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 09B

The previous generation of robotic vehicles and drones was designed for a specific task, with limited flexibility in executing their mission. This limited flexibility arises because the robotic vehicles do not possess the intelligence and knowledge upon which to make significant tactical decisions. Current development of robotic vehicles is toward increased intelligence and capabilities, adapting to a changing environment and altering mission objectives. The latest techniques in artificial intelligence (AI) are being employed to increase the robotic vehicle's intelligent decision-making capabilities. This document describes the design of the SARA spatial database tool, which is composed of request parser, reasoning, computations, and database modules that collectively manage and derive information useful for robotic vehicles. Author

N88-17279*# Mitre Corp., Houston, Tex.
TASK-LEVEL ROBOT PROGRAMMING: INTEGRAL PART OF EVOLUTION FROM TELEOPERATION TO AUTONOMY c63
James C. Reynolds *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 533-540 (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 09B

An explanation is presented of task-level robot programming and of how it differs from the usual interpretation of task planning for robotics. Most importantly, it is argued that the physical and mathematical basis of task-level robot programming provides inherently greater reliability than efforts to apply better known concepts from artificial intelligence (AI) to autonomous robotics. Finally, an architecture is presented that allows the integration of task-level robot programming within an evolutionary, redundant, and multi-modal framework that spans teleoperation to autonomy. Author

N88-17280*# Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio. Air Crew Escape Group.
HYPERVELOCITY TECHNOLOGY (HVT) CREW ESCAPE c54
Lanny A. Jines *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 541-547 (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 05H

Conceptual designs are being investigated for escape systems applicable to hypervelocity technology class aerospace vehicles. The concepts selected for further development will provide survivable escape and recovery throughout all phases of flight. Sixteen conceptual escape systems were identified, of which two were viable. The study vehicles included a horizontally launched

vehicle (HLV) and a vertically launched vehicle (VLV). Computer-aided design models of the candidate escape systems were developed. State-of-the-art or near-term enabling technologies were identified in such areas as propulsion, life support, thermal protection, and deceleration. Author

N88-17281*# Essex Corp., Orlando, Fla.
SURROGATE MEASURES: A PROPOSED ALTERNATIVE IN HUMAN FACTORS ASSESSMENT OF OPERATIONAL MEASURES OF PERFORMANCE c54
Robert S. Kennedy, Norman E. Lane, and Lois A. Kuntz *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 551-558 (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 05H

Surrogate measures are proposed as an alternative to direct assessment of operational performance for purposes of screening agents who may have to work under unusual stresses or in exotic environments. Such measures are particularly proposed when the surrogate can be empirically validated against the operational criterion. The focus is on cognitive (or throughput) performances in humans as opposed to sensory (input) or motor (output) measures, but the methods should be applicable for development of batteries which will tap input/output functions. A menu of performance tasks is under development for implementation on a battery-operated portable microcomputer, with 21 tests currently available. The tasks are reliable and become stable in minimum amounts of time; appear sensitive to some agents; comprise constructs related to actual job tasks; and are easily administered in most environments. Implications for human factors engineering studies in environmental stress are discussed. Author

60 COMPUTER OPERATIONS AND HARDWARE

Includes hardware for computer graphics, firmware, and data processing.

For components see *33 Electronics and Electrical Engineering.*

N88-17282# Massachusetts Inst. of Tech., Cambridge. Lab. for Computer Science.
COMMUNICATIONS PATTERNS IN A SYMBOLIC MULTIPROCESSOR
Peter R. Nuth Jun. 1987 194 p
(Contracts N00014-83-K-0125; N00014-84-K-0099)
(AD-A186896; MIT/LCS/TR-395) Avail: NTIS HC A09/MF A01 CSCL 09B

An important design decision for large scale multiprocessors is the balance of processor power to communication network bandwidth. In order to evaluate different design alternatives, it is necessary to be able to predict the load imposed on the network by a programming model. This thesis quantifies that communication load for a model of parallel symbolic computing using the Multilisp language. An organization of a shared memory multiprocessor for Multilisp is proposed. The Nusim architectural simulator is built to model that organization. Several Multilisp application programs are run under Nusim, and the communication requirements of each program is measured. The locality of reference of memory accesses for the benchmarks is determined for three proposed multiprocessor topologies. The effect of scheduling decisions in increasing locality of access and in reducing global communication is studied. The thesis concludes with implications of scheduling policies on the design of parallel computer systems. GRA

N88-17283# University of Southern California, Los Angeles. Computer Research Inst.
SUPERCOMPUTERS FOR SOLVING PDE (PARTIAL DIFFERENTIAL EQUATIONS) PROBLEMS Final Report, 20 Sep. 1986 - 11 Aug. 1987
Kai Hwang 11 Aug. 1987 10 p
(Grant AF-AFOSR-0008-86)
(AD-A186583; AFOSR-87-1275TR) Avail: NTIS HC A02/MF A01 CSCL 09B

This project investigated parallel/vector supercomputer architectures for solving Air Force problems, which demand the solution of partial differential equations (PDEs). We have developed an orthogonal multiprocessor (OMP) architecture for efficiently implementing the SLOR and ADI methods in solving PDEs. Another parallel PDE machine architecture, called the V-tree multiprocessor, has been developed for mapping the multigrid algorithms. This V-tree is shown to be more effective than the well-known hypercube and mesh architectures. Both the OMP and the V-tree architectures can demonstrate linear speedup by exploiting parallelism and vectorization. Continued efforts are needed to expand these initial studies into real hardware experiments and software simulations to verify the theoretical predictions on speedup performance. GRA

N88-17284# Technische Hogeschool, Delft (Netherlands).
THE Ada COMPILER: ON THE DESIGN AND IMPLEMENTATION OF AN Ada COMPILER Ph.D. Thesis
Jan vanKatwijk 1987 240 p
(ETN-88-91594) Avail: NTIS HC A11/MF A01

A compiler model suitable for the translation of a large language applied in the Ada compiler is described. Compiler front end practical aspects in overload resolution, and the efficient implementation of the scope and visibility rules are discussed. The compiler back end run-time data description model is outlined. The translation of higher-level language constructs is given. Low-level intermediate languages are mentioned. Design and implementation of an Ada tasking supervisor and of a program-library manager are considered. ESA

N88-17285# Stanford Linear Accelerator Center, Calif.
HIGH PERFORMANCE DATA BUSES: PROGRESS AND EVOLUTION
D. B. Gustavson Sep. 1987 4 p Presented at the Nuclear Science Symposium, San Francisco, Calif., 21 Oct. 1987
(Contract DE-AC03-76SF-00515)
(DE88-002570; SLAC-PUB-4414; CONF-871006-11) Avail: NTIS HC A02/MF A01

In 1987 four new 32-bit computer backplane buses joined Fastbus as IEEE standards. They are Futurebus, VME, NuBus, and Multibus-II. This paper compares and contrasts these buses, discusses their strengths and weaknesses, and considers possible directions for future improvement. Some of these buses have reached fundamental limits. How can they be improved. Can they be extended in ways which are backward compatible with present buses, or will they be abandoned in favor of new designs. What direction will new bus designs take. DOE

N88-17286# Illinois Univ., Urbana.
INTERFACING SLAVE DESIGNS TO FASTBUS: PRACTICAL EXPERIENCE
R. W. Downing, J. J. Hoeflich, and V. J. Simaitis 1987 4 p Presented at the Nuclear Science Symposium, San Francisco, Calif., 21 Oct. 1987 Prepared in cooperation with European Organization for Nuclear Research, Geneva, Switzerland
(Contract DE-AC02-76ER-01195)
(DE88-002807; CONF-871006-16) Avail: NTIS HC A02/MF A01

Standard interface designs help: (1) eliminate design errors, (2) reduce design efforts, and (3) lead to a uniform bus-protocol interpretation. We have designed a number of Fastbus slave modules, using a standard interface circuit and standard design-verification tools based on Computer-Aided-Engineering (CAE) techniques. In this paper, we describe the standard interface, and the design and verification methodology. DOE

N88-17287*# Sterling Federal Systems, Inc., Palo Alto, Calif.
A COMPARISON OF THE CRAY-2 PERFORMANCE BEFORE AND AFTER THE INSTALLATION OF MEMORY PSEUDO-BANKING

Ronald D. Schmickley and David H. Bailey 16 Jun. 1987 9 p
(Contract NAS2-11555)
(NASA-CR-177462; NAS 1.26:177462; TN-86-7104-939-13)
Avail: NTIS HC A02/MF A01 CSCL 09B

A suite of 13 large Fortran benchmark codes were run on a Cray-2 configured with memory pseudo-banking circuits, and floating point operation rates were measured for each under a variety of system load configurations. These were compared with similar flop measurements taken on the same system before installation of the pseudo-banking. A useful memory access efficiency parameter was defined and calculated for both sets of performance rates, allowing a crude quantitative measure of the improvement in efficiency due to pseudo-banking. Programs were categorized as either highly scalar (S) or highly vectorized (V) and either memory-intensive or register-intensive, giving 4 categories: S-memory, S-register, V-memory, and V-register. Using flop rates as a simple quantifier of these 4 categories, a scatter plot of efficiency gain vs Mflops roughly illustrates the improvement in floating point processing speed due to pseudo-banking. On the Cray-2 system tested this improvement ranged from 1 percent for S-memory codes to about 12 percent for V-memory codes. No significant gains were made for V-register codes, which was to be expected. Author

N88-17288*# Sterling Federal Systems, Inc., Palo Alto, Calif.
A PERFORMANCE COMPARISON OF THE CRAY-2 AND THE CRAY X-MP
Ronald Schmickley and David H. Bailey 14 Mar. 1986 7 p
(Contract NAS2-11555)
(NASA-CR-177461; NAS 1.26:177461; TN-86-7104-939-12)
Avail: NTIS HC A02/MF A01 CSCL 09B

A suite of thirteen large Fortran benchmark codes were run on Cray-2 and Cray X-MP supercomputers. These codes were a mix of compute-intensive scientific application programs (mostly Computational Fluid Dynamics) and some special vectorized computation exercise programs. For the general class of programs tested on the Cray-2, most of which were not specially tuned for speed, the floating point operation rates varied under a variety of system load configurations from 40 percent up to 125 percent of X-MP performance rates. It is concluded that the Cray-2, in the original system configuration studied (without memory pseudo-banking) will run untuned Fortran code, on average, about 70 percent of X-MP speeds. Author

N88-16733# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Data Handling Div.
INTRODUCING NEW TECHNOLOGY INTO ONBOARD HANDLING SYSTEMS
M. A. Perry, P. May, and W. Walker *In its* ESA Bulletin No. 10 Aug. 1977 p 33-37 (For primary document see N88-16728 09-12)
Avail: NTIS HC A05/MF A01

61 COMPUTER PROGRAMMING AND SOFTWARE

Includes computer programs, routines, alogorithms, and specific applications, e.g., CAD/CAM.

N88-17289# Naval Postgraduate School, Monterey, Calif.
COMPUTER ASSISTED INSTRUCTION: TWO DECADES IN PERSPECTIVE M.S. Thesis
Thomas J. Hoskins, Jr. and Janet D. Orrell Sep. 1987 82 p
(AD-A186813) Avail: NTIS HC A05/MF A01 CSCL 05I

The changes that have occurred in Computer Assisted Instruction (CAI) over the past 20 years are examined. Numerous literature sources were reviewed and the information extracted was utilized to describe the history of CAI; provide a brief description of other types of computer-based education that are often grouped under the heading of CAI; examine the changes in hardware and software costs; describe the interaction of educators and software developers; reflect on the future of CAI; examine the development of computer-based instruction for Navy technical training, and make some comparisons between the public sector's use of computer-based instruction and the Navy's. Conclusions center on the benefits of CAI with regard to learning improvement; inadequate teacher training; failure to plan for implementation of hardware and software, and the less than optimal, but improving, interaction between educators and software developers. GRA

N88-17290# Massachusetts Inst. of Tech., Cambridge. Lab. for Computer Science.
TYPES AND EFFECTS TOWARDS THE INTEGRATION OF FUNCTIONAL AND IMPERATIVE PROGRAMMING Ph.D. Thesis
John M. Lucassen Aug. 1987 161 p
(Contract N00014-83-K-0125)
(AD-A186930; MIT/LCS/TR-408) Avail: NTIS HC A08/MF A01 CSCL 09B

We propose a new class of programming languages in which every expression has both a type and an effect: the type describes what sort of value the expression may return, and the effect describes what sort of side-effects the expression may have. Effects are described in terms of regions, which describe what part of the state of the computation may be affected. We show how the type system of the second-order lambda-calculus can be generalized to incorporate effect and region specifications. This leads to polymorphism with respect to types, effects, and regions. Our type and effect system makes it possible to embed functional program fragments within imperative programs, and vice versa, while retaining the benefits of the chosen programming style in each program fragment. The type and effect system can also be used to verify the encapsulation invariant of a monitored data type. It also offers a clean solution to the problem of first-class polymorphism in an imperative language. To test our ideas, we have designed a small imperative higher-order language called MFX, and we have implemented a compiler that analyzes MFX programs and translates them into dataflow graphs. GRA

N88-17291# Army Cold Regions Research and Engineering Lab., Hanover, N.H.
AN AUTOMATIC FINITE ELEMENT MESH GENERATOR
Mary R. Albert and James L. Warren Sep. 1987 38 p
(AD-A186939; CRREL-87-18) Avail: NTIS HC A03/MF A01 CSCL 09B

Finite element computer codes are used in a variety of fields to solve partial differential equations of importance in science and engineering. The initial input to all of these programs requires the formation of a mesh (i.e., extensive lists of geometrical data listed in particular orders), and the success of the solution depends on a well-formed mesh. This report documents a mathematical mapping technique and its implementation into a user-friendly computer code that will automatically generate quality finite element meshes. This versatile generator uses standard FORTRAN, requires no special equipment (such as a digitizer), is very economical to run, and is user-friendly. The mathematical technique is discussed, advantages and limitations of the method are presented, and examples are shown, and notes on user instructions are provided. GRA

N88-17292# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Systems and Logistics.
EVALUATING SOFTWARE TESTING METHODS TO REDUCE TESTING DUPLICATION IN US ARMY COMMUNICATIONS EQUIPMENT ACQUISITION M.S. Thesis
John D. Burke Sep. 1987 113 p
(AD-A186961; AFIT/GLM/LSM/87S-9) Avail: NTIS HC A06/MF A01 CSCL 09B

The purpose of this thesis was to compare the software testing procedures at Fort Monmouth, N.J. by three offices and compare them against an industry baseline developed from current literature on software testing and program management. Program management offices at Fort Monmouth use two Communications-Electronics Command (CECOM) test agencies, the Center for Life

Cycle Software Engineering (CLCSE) and the Product Assurance and Test Directorate (PA and T), to monitor and evaluate software both in terms of life cycle support and acceptance testing. This study had three objectives: (1) Develop an industry standard on software testing based on current literature. (2) Transform this industry standard into an interview questionnaire and conduct personal interviews with personnel in the three offices. (3) Identify similarities and differences between the industry baseline and a composite of the interview results. GRA

N88-17293# Harry Diamond Labs., Adelphi, Md.
FRACTAL IMAGES: PROCEDURE AND THEORY Final Report, May - Dec. 1986
Stephen D. Casey Aug. 1987 46 p
(AD-A187014; HDL-TR-2119) Avail: NTIS HC A03/MF A01 CSCL 09B

The paper gives a study on the theory and production of fractals. It focuses on three areas in which fractals appear: dynamical systems, scaling, and random motion. In the section on dynamical systems, the dynamics of functions of one complex variable are discussed. The section on scaling includes a discussion of seed fractals, as well as a discussion of fractional dimension. The section on random motion is a discussion of squig fractals. In each section, sample images and computer code/pseudocode are provided. The paper concludes with application of fractals to digital signal processing. GRA

N88-17294# Massachusetts Inst. of Tech., Cambridge. Lab. for Computer Science.
NESTED TRANSACTIONS, CONFLICT-BASED LOCKING, AND DYNAMIC ATOMICITY
Alan Fekete, Nancy Lynch, Michael Merritt, and William Weihl Sep. 1987 57 p
(Contracts N00014-85-K-0168; N00014-83-K-0125)
(AD-A187033; MIT/LCS/TM-340) Avail: NTIS HC A04/MF A01 CSCL 09B

This paper examines some concurrency control algorithms for nested transaction systems. A simple local property called dynamic atomicity is defined for data objects in such a system, and we show that all the executions of a system are serially correct (despite concurrency and transaction aborts) provided each data object is dynamic atomic. This result is applied to give a correctness proof for a new algorithm, called Conflict Based Locking (CBL), for managing data in a nested transaction system. The algorithm uses a table specifying which operations may not proceed concurrently to determine when an operation may be granted a lock on an object. The algorithm is an extension of a general conflict-based locking protocol introduced by Weihl for transaction systems without nesting. It is also similar to Moss' algorithm, which uses read- and write- locks and a stack of versions of each object to ensure the serializability and recoverability of transactions accessing the data. We show that objects implemented using Moss' algorithm of the new Conflict-Based Locking algorithm are dynamic atomic. Thus it follows that if each object in a nested transaction system uses either Moss' algorithm or the new Conflict-Based Locking algorithm, then all executions of the system will be serially correct. GRA

N88-17295# Rome Air Development Center, Griffiss AFB, N.Y.
MATHEMATICAL STRUCTURES FOR SPEECH RECOGNITION Report, Apr. 1985 - Dec. 1986
Wayne Todd Jul. 1987 29 p
(AD-A187063; RADC-TR-87-109) Avail: NTIS HC A03/MF A01 CSCL 09B

THe Mathematical Intelligence (MI) Development System was implemented in a DEC PDP 11/70 computer, an FPS 5210 array processor, and a Ramtek 9465 color graphics display. The two major components of the system are the Digital Speech Processing Tool and the MI Speech Recognizer. THe MI Speech Recognizer was informally tested for pitch extraction and results were encouraging. Additional work is necessary to formally test the MI Speech Recognizer and complete the MI Development System. GRA

N88-17296# Massachusetts Inst. of Tech., Cambridge. Lab. for Computer Science.
RECOVERY USING VIRTUAL MEMORY
Elliot K. Kolodner Jul. 1987 94 p
(Contract N00014-83-K-0125; Grant NSF DCR-85-03662)
(AD-A187098; MIT/LCS/TR-404) Avail: NTIS HC A05/MF A01 CSCL 09B

Maintaining the consistency of long-lived on-line data in the presence of failures is important for many applications such as airline reservation and banking systems. After a crash, the long-lived data must be recovered for the application to continue running. Storing the data and later restoring it is the job of a recovery system. Presented is a new recovery method with two features: it is fast because as much as possible it uses data already stored by an application in virtual memory for recovery, and it is novel because it allows data in virtual memory to be organized in a heap with automatic garbage collection. The recovery method is designed to be used in the Argus system, but it will also work for other persistent storage systems. GRA

N88-17297# Honeywell Systems and Research Center, Minneapolis, Minn.
RATIONALE FOR THE DESIGN OF THE ADA (TRADENAME) PROGRAMMING LANGUAGE
Jean D. Ichbiah, John G. Barnes, Robert J. Firth, and Mike Woodger 1986 410 p Sponsored by DOD, Washington, D.C. Prepared in cooperation with Alsys, Saint Cloud, France
(AD-A187106) Avail: NTIS HC A18/MF A01 CSCL 12A

Topics addressed include: Lexical and Textual Structure; Classical Programming; Types; Numeric Types; Access Types; Derived Types; Subprograms; Packages; Separate Compilation and Libraries; General Program Structure - Visibility and Overloading; Generic Units; Tasking; Exception Handling; Representation Clauses and Machine Dependencies; and Input-Output. GRA

N88-17298# Pittsburgh Univ., Pa. Inst. for Computational Mathematics and Applications.
MULTICOLOR NUMBERING OF IRREGULAR TRIANGULAR MESHES
Rami G. Melhem and K. V. Ramarao Jun. 1987 33 p
(Contract N00014-85-K-0339; Grant AF AFOSR-0131-84)
(AD-A186559; ICMA-87-110) Avail: NTIS HC A03/MF A01 CSCL 09B

Many iterative algorithms for the solution of large linear systems may be effectively vectorized only if the diagonal of the matrix is surrounded by a large band of zeroes, which is called the zero stretch. In this paper, a multicolor numbering technique is suggested for maximizing the zero stretch of irregularly sparse matrices. The technique, which is generalization of a known algorithm for regularly sparse matrices, executes in linear time, and produces a zero stretch approximately equal to n sub 2 sigma, where sigma is the number of colors used in the algorithm. For triangular meshes, it is shown that sigma is less than or equal to 3, and that it is possible to obtain omega = 2 by applying a simple backtracking scheme. GRA

N88-17299# Purdue Univ., West Lafayette, Ind.
ALGORITHM DESIGN FOR SCIENTIFIC COMPUTATION FOR HIGHLY PARALLEL MULTIPROCESSOR SYSTEMS Final Report
Dennis Gannon 1987 3 p
(Grant AF-AFOSR-0123-85)
(AD-A186713; AFOSR-87-1454TR) Avail: NTIS HC A02/MF A01 CSCL 09B

As part of the AFOSR Fast Algorithms Initiative, the project focused on the design of parallel algorithms and the related software design problems associated with multiprocessor systems. The research work was divided into two phases. The primary emphasis of the first phase was to study new algorithm ideas for solving the large numerical linear algebra problems associated with two and three dimensional elliptic P.D.E. problems. The work in the second phase of the research was directed toward

understanding the software mechanisms needed to map these algorithms to existing parallel computers. GRA

N88-17300# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
VOICE TECHNOLOGY USING PERSONAL COMPUTERS M.S. Thesis
Gary L. Talbot 1987 272 p
(AD-A186743; AFIT/CI/NR-87-43T) Avail: NTIS HC A12/MF A01 CSCL 09B

The software project had two objectives, the first objective and subject of Part I was to develop a Turbo Pascal procedure to drive the IBM Voice Communications Application Program Interface software which interfaces the IBM Voice Communications Adapter hardware to synthesize speech from text. The resulting Turbo Pascal procedure, SPEAK.INC, was designed to allow any user the ability to produce speech-from-text from within any Turbo Pascal program. In addition, three application programs that can be applied for introductions, explanations, error messages, etc., were developed using the procedure. The second objective, covered in Part II, explores voice recognition tools through the IBM Voice-Activated Keyboard Utility. This utility allows user-defined applications to be built that free the user from the keyboard during interaction with group members in discussions, presentations, etc., of in any situation where the user requires mobility from the keyboard. In Chapter Five, a user guide with an example user application is provided to assist setting up applications incorporating the utility to use voice recognition. GRA

N88-17301# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany). Abteilung Regelung.
FORTRAN 77 GUIDELINES FOR THE SOFTWARE PROJECTS RASP AND ANDECS
Martin Otter May 1987 34 p In GERMAN; ENGLISH summary
(DFVLR-Mitt-87-09; ISSN-0176-7739; ETN-88-91379) Avail: NTIS HC A03/MF A01; DFVLR, Cologne, Federal Republic of Germany DM 13

The guidelines for programming in FORTRAN 77, which were defined for the software projects RASP and ANDECS, were collected. Error treatment and architectural design are discussed. The reason for each guideline is explained. Suggestions for the transition from FORTRAN 4 to FORTRAN 77 are given. ESA

N88-17302# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Computer Science/Dept. of Interactive Systems.
INTERACTIVE GENERATION OF FRACTAL OBJECTS
J. A. Kaandorp Jan. 1987 20 p Submitted for publication
(CWI-CS-R8706; B8711192; ETN-88-91568) Copyright Avail: NTIS HC A03/MF A01

Data structures by which a large class of fractal objects can be represented using production rules, and an algorithm to generate these objects are described. The data structures and algorithm can be used to produce many of the classical examples of self-similar sets, mentioned for example by Mandelbrot (1982). The algorithm and data structures are part of a fractal system by which production rules can be designed; production rules can be retrieved from and stored in a fractal library. ESA

N88-17303# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Numerical Mathematics.
IMPLEMENTATION OF ELEMENTARY FUNCTIONS IN Ada
M. Bergman Apr. 1987 18 p Sponsored by the Commission of the European Communities
(CWI-NM-R8709; B8717214; ETN-88-91577) Copyright Avail: NTIS HC A03/MF A01

A package of basic mathematical functions for Ada was designed and implemented. It meets requirements like portability, general usefulness and efficiency. The way the elementary functions are implemented is detailed. ESA

N88-17304# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Numerical Mathematics.
DESIGN AND IMPLEMENTATION OF ELEMENTARY FUNCTIONS IN AdA
Jan Kok Apr. 1987 23 p Sponsored by the Commission of the European Communities
(CWI-NM-R8710; B8717215; ETN-88-91578) Copyright Avail: NTIS HC A03/MF A01

The specification of a generic package for the declaration of the elementary functions in Ada which employs the library error handling mechanism is presented. The portable implementation of this package, and work on testing and documenting the package are described. ESA

N88-17305# Technische Hogeschool, Delft (Netherlands).
SOLID MODELLING WITH FACETED PRIMITIVES Ph.D. Thesis
Frederik Willem Jansen 1987 113 p
(ETN-88-91593) Avail: NTIS HC A06/MF A01

A constructive solid geometry (CSG) representation where the surfaces of the primitives are approximated with flat surface elements (facets) was developed. Techniques to improve the efficiency of the display of models with a large number of these surface elements were derived. Two approaches were taken. The first approach is based on the use of additional data structures to enhance the processing, sorting, and search of the surface elements. A method to store intermediate results of the logical computations needed for the processing of CSG representations is presented. The methods are applied to a CSG polygon modeling system. The second approach aims at the development of algorithms for multiprocessor systems and VLSI-based display systems. The central method is a CSG depth-buffer algorithm. A tree traversal method that combines several techniques to reduce the processing and memory use is introduced. The methods were applied to a CSG halfspace modeling system. ESA

N88-17306# Helsinki Univ. of Technology, Espoo (Finland). Dept. of Computer Science.
METHODOLOGICAL AND STRUCTURAL PRINCIPLES FOR FLEXIBLE GEOMETRIC MODELING IN COMPUTER AIDED DESIGN Ph.D. Thesis
Tapio Takala 1987 34 p Previously announced in IAA as A87-52098 Sponsored in part by the Academy of Finland, and the Technology Development Center
(Ma-48; ISBN-951-666-244-7; ISSN-0355-2713; ETN-88-91660) Avail: NTIS HC A03/MF A01

Based on the foundations of design theory, a transaction model of the design process which corresponds to the composition of an object model from the basic interactive operations is presented. Geometric modeling aspects are discussed mathematically, and the solid boundary representation scheme is generalized to all dimensions, including computer graphics. This unified methodology makes it possible to construct geometric object models from basic graphical actions. Architectural aspects of computer aided design systems to support the flexible methodology are discussed, and an object-oriented approach is suggested as the most natural paradigm. The AGX system, based on these flexible modeling principles, is presented with concrete design examples. ESA

N88-17307# Logica Ltd., London (England).
HARDWARE/SOFTWARE RELIABILITY STUDY Final Report
Peter Mellor Paris, France ESA Jan. 1987 261 p
(Contract ESA-6640/86-NL-MA)
(Rept-65.5686; ESA-CR(P)-2494; ETN-88-91427) Avail: NTIS HC A12/MF A01

Techniques for reliability analysis of the logical part of hardware/software systems are reviewed, and recommendations for requirements and analysis techniques needed to demonstrate compliance are made. Working practices to be used to assess software reliability in order to demonstrate compliance with requirements, and a comprehensive technical background of techniques and tools which can be used to assess hardware/software reliability are presented. Working practices to be used in collecting data for an assessment of software reliability

are included, because of the nature of software reliability assessment techniques which involves a statistical analysis of the failure history of a system during trial. It is therefore essential that the necessary data be recorded during development, test, trial, and operation of a hardware/software system. ESA

N88-17308# Admiralty Research Establishment, Portland (England).
DESCRIPTION OF A LIMITED VAX-Ada PROGRAM SUPPORT ENVIRONMENT DEVELOPED WITHIN UDP DIVISION VERSION 1.0
M. T. Harvey May 1987 37 p
(ARE-TM(UDP)-87103; ACCN-75449; BR102676; ETN-88-91508)
Copyright Avail: NTIS HC A03/MF A01

A limited program support environment was designed for use with the DEC VAX-Ada compiler. The environment structure, how it should be used, and details of all the available tools are described. ESA

N88-17309 National Physical Lab., Teddington (England). Div. of Information Technology and Computing.
CONTRIBUTIONS TO A NUMERICAL LIBRARY IN Ada
G. T. Symm Aug. 1987 70 p
(NPL-DITC-98/87; ISSN-0262-5369; ETN-88-91523) Copyright Avail: Issuing Activity

A package of subprograms for the boundary element solution of Laplace's equation in a simply-connected domain subject to Robin boundary conditions is described. This package forms the initial contents of the partial differential equations chapter of an Ada library which is also outlined. A procedure for linear equations is discussed. ESA

N88-17310# Royal Aircraft Establishment, Farnborough (England).
HANDBOOK OF THE GEMS IMAGE PROCESSING SYSTEM
K. H. Bagot Sep. 1986 193 p Original contains color illustrations
(RAE-TR-86062; RAE-SPACE-664; BR100999; ETN-88-92033)
Copyright Avail: NTIS HC A09/MF A01

A satellite image processing system is presented. Although many of the processes in the system come from experience of handling LANDSAT Multi-Spectral Scanner imagery, they are implemented in a very general way. The system can cope with 20 images, making it suitable for examining data from the Thematic Mapper (7 bands), airborne scanner systems (11 typical), and multitemporal images (up to 20). The system can cope with an intensity range of -32768 to 32767, making it suitable for the examination of data from NOAA, satellites (0 to 1023) and radar imaging systems (e.g., Seasat SAR, 0 to 8191). Floating point numbers are also supported. ESA

N88-17311# Royal Signals and Radar Establishment, Malvern (England).
FORMAL GRAMMARS AND MARKOV MODELS
J. S. Bridle and L. Dodd Oct. 1987 18 p
(RSRE-MEMO-4051; BR103727; ETN-88-91541) Copyright Avail: NTIS HC A03/MF A01

The links between formal grammars and Markov models via stochastic grammars are shown. Stochastic context-free grammars are suggested for practical application. ESA

N88-17312# Institut National des Sciences Appliquees de Lyon, Villeurbanne (France). Lab. d'Informatique Appliquee.
Occam/Ada PARALLEL PROGRAMMING SYSTEM Ph.D. Thesis [SYSTEME DE PROGRAMMATION PARALLELE OCCAM/ADA]
Mabrouk Nekkache 1987 133 p In FRENCH; ENGLISH summary
(ISAL-IDI1-87-11; ETN-88-91630) Avail: NTIS HC A07/MF A01

A programming tool to specify and develop real time applications in Ada language is presented. The Occam system was chosen as a basis and translated into Ada language. Programming is regarded as a scheduling activity rather than a sequencing one. The problems involved included splitting systems in smaller parallel systems, synchronizing of the components, and mutual exclusion of shared variables. Application experience indicates that Occam may be considered a language for specification and development in Ada. ESA

N88-17313*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
GENERAL ROTORCRAFT AEROMECHANICAL STABILITY PROGRAM (GRASP) VERSION 1.03: USER'S MANUAL
A. Stewart Hopkins and Donald L. Kunz (Army Aviation Research and Development Command, Moffett Field, Calif.) Feb. 1988 64 p
(NASA-TM-100043; A-88028; NAS 1.15:100043; USAAVSCOM-TR-87-A-12) Avail: NTIS HC A04/MF A01 CSCL 09B

The Rotorcraft Dynamics Division, Aeroflightdynamics Directorate, U.S. Army Aviation Research and Technology Activity has developed the General Rotorcraft Aeromechanical Stability Program (GRASP) to perform calculations that will assess the stability of rotorcraft in hovering flight and ground contact conditions. The program is designed to be state-of-the-art, hybrid, finite-element/multibody code that can be applied to all existing and future helicopter configurations. While GRASP was specifically designed to solve rotorcraft stability problems, its innovative structure and formulation allow for application to a wide range of structures. This manual describes the preparation of the input file required by Version 1.03 of GRASP, the procedures used to invoke GRASP on the NASA Ames Research Center CRAY X-MP 48 computer, and the interpretation of the output produced by GRASP. The parameters used by the input file are defined, and summaries of the input file and the job control language are included. Author

N88-17314# Association Aeronautique et Astronautique de France, Paris.
METHODS FOR EVALUATING THE QUALITY AND RELIABILITY OF AERODYNAMIC SOFTWARE PROGRAMS
G. Heckmann Nov. 1986 51 p In FRENCH Presented at the 23rd Colloque d'Aerodynamique Appliquee, Modane, France, 12-14 Nov. 1986 Sponsored by Direction des Recherches, Etudes et Techniques, Paris, France Prepared in cooperation with Avions Marcel Dassault-Breguet Aviation, Saint-Cloud, France
(PB87-169793; NOTE-TECHNIQUE-86-02; ISBN-2-7170-0850-0)
Avail: NTIS HC E04/MF E04 CSCL 09B

Industrial calculation codes in the sixties, seventies, and today; industrial needs; types and levels of needs; types and levels of programs; the reliability of conversational codes; and mesh programs are discussed. It is suggested that codes be evaluated by observing discrepancies between software calculations and data obtained during flight tests and wind tunnel trials of planes under development. Specific tests can also be developed for the express purpose of evaluating software and the data used in the same way as that obtained from ordinary wind tunnel tests. Author

N88-17315# Association Aeronautique et Astronautique de France, Paris.
SOFTWARE PROGRAM VALIDITY: A SURVEY
G. Ruggiu Nov. 1986 21 p In FRENCH Presented at the 23rd Colloque d'Aerodynamique Appliquee, Modane, France Sponsored by Direction des Recherches, Etudes et Techniques, Paris, France Prepared in cooperation with Societe Bertin et Cie, Plaisir, France
(PB87-170593; NOTE-TECHNIQUE-86-01; ISBN-2-7170-0849-7)
Avail: NTIS HC E03/MF E03 CSCL 09B

A general discussion is given of the problems associated with evaluating the reliability and validity of software programs as industrial products. The author stresses that validity should be judged on the basis of the program writer's intensions, rather than on the program's ability to solve a particular user's particular problem. The logic of programs, the limitations of formal systems, the formal semantics of programming languages, program proofs

and the changes brought about by research in program logic are discussed. Author

N88-17316# Groningen Rijksuniversiteit (Netherlands). Subfaculteit Wiskunde en Informatica.
TWISTED CUBE
P. A. J. Hilbers, M. R. J. Koopman, and J. L. A. vandeSnepscheut 29 Sep. 1986 10 p
(PB87-162814; CS-8607) Avail: NTIS HC E03/MF E01
CSCL 09B

Properties that make the binary cube an attractive interconnection network for many-processor machines include expansibility, a simple routing-algorithm, and a diameter that grows logarithmically with the number of processors. An operation called twist that delivers two edges is introduced. By applying a twist to a number of judiciously chosen edges, a cube is transformed into a so-called twisted cube. It is shown that the twisted cube has a diameter which is roughly half the diameter of the original cube, that a routing algorithm exists, albeit a more complex one, and that expansibility is retained. GRA

N88-17317# Groningen Rijksuniversiteit (Netherlands). Subfaculteit Wiskunde en Informatica.
ALGORITHMS FOR TRANSITIVE REDUCTION OF AN ACYCLIC GRAPH
D. Gries, A. J. Martin, and J. L. A. vandeSnepscheut 27 Nov. 1986 10 p
(PB87-162822; CS-8608) Avail: NTIS HC E03/MF E01
CSCL 09B

Two algorithms for computing the transitive reduction of a finite, directed acyclic graph are discussed. The first algorithm is derived in the by now standard way of first developing an invariant and then obtaining the program from it. The second algorithm was discovered by attempting to invert Warshall's algorithm for computing the transitive closure of a graph. Thus, the concept of program inversion could not be strictly used. Since it could not be strictly used, the proof of correctness of Warshall's algorithm could not be simply inverted to yield the proof of correctness for the reduction algorithm. Contrary to the first algorithm, the second algorithm is an in-situ algorithm for transitive reduction. After having established the existence of an in-situ algorithm through program inversion, the derivation of the first algorithm was further refined to lead to the second algorithm. GRA

N88-17318# EI International, Inc., Idaho Falls, Idaho.
PATTERN-RECOGNITION SOFTWARE DETECTING THE ONSET OF FAILURES IN COMPLEX SYSTEMS
J. Mott and R. King 1987 18 p Presented at the 42nd Meeting of Mechanical Failures Prevention Group, Gaithersburg, Md., 15 Sep. 1987 Prepared in cooperation with Argonne National Lab., Idaho Falls, Idaho
(Contract W-31-109-eng-38)
(DE88-002861; CONF-8709204-1) Avail: NTIS HC A03/MF A01

A very general mathematical framework for embodying learned data from a complex system and combining it with a current observation to estimate the true current state of the system has been implemented using nearly universal pattern-recognition algorithms and applied to surveillance of the Experimental Breeder Reactor-2 (EBR-2) power plant. In this application the methodology can provide signal validation and replacement of faulty signals on a near-real-time basis for hundreds of plant parameters. The mathematical framework, the pattern-recognition algorithms, examples of the learning and estimating process, and plant operating decisions made using this methodology are discussed. The entire methodology has been reduced to a set of FORTRAN subroutines which are small, fast, robust and executable on a personal computer with a serial link to the system's data acquisition computer, or on the data acquisition computer itself. DOE

N88-17319# Oak Ridge National Lab., Tenn.
A COMPARISON OF ALGORITHMS FOR THE ANALYSIS OF IMAGES GENERATED BY TWO-DIMENSIONAL ELECTROPHORESIS
R. C. Mann, D. J. Riese, B. K. Mansfield, and J. K. Selkirk Nov. 1987 20 p
(Contract DE-AC05-84OR-21400)
(DE88-003730; ORNL/TM-10591) Avail: NTIS HC A03/MF A01

Three algorithms for quantitative 2-D gel electrophoresis were compared when applied to a set of simulated images, and to gel images obtained with separated cytoplasmic proteins of FELC. The methods involved fitting of Gaussian surfaces to protein spots as well as quantitation that did not rely on any assumptions concerning the distribution of radioactivity within a protein spot. Image processing algorithms preceding the analysis were identical for the three methods. Results based on isolated spots show that for the majority of cases there is no statistical difference between the estimates produced by the three methods. This suggest that computationally expensive fitting of two-dimensional surfaces is not necessary in order to achieve satisfactory quantitation. DOE

N88-17320# Lawrence Livermore National Lab., Calif.
A FAST BOTTOM-UP ALGORITHM FOR COMPUTING THE CUT SETS OF NONCOHERENT FAULT TREES
G. C. Corynen Nov. 1987 60 p
(Contract W-7405-eng-48)
(DE88-003741; UCRL-53828) Avail: NTIS HC A04/MF A01

An efficient procedure for finding the cut sets of large fault trees was developed. Designed to address coherent or noncoherent systems, dependent events, shared or common-cause events, the method - called SHORTCUT - is based on a fast algorithm for transforming a noncoherent tree into a quasi-coherent tree (COHERE), and on a new algorithm for reducing cut sets (SUBSET). To assure sufficient clarity and precision, the procedure is discussed in the language of simple sets, which is also developed in this report. Although the new method has not yet been fully implemented on the computer, we report theoretical worst-case estimates of its computational complexity. DOE

N88-17321# Rice Univ., Houston, Tex.
A RASTER SCAN ALGORITHM FOR GENERATING VISIBLE PARAMETRIC SURFACES
J. E. Akin and W. H. Gray 1987 5 p Presented at the Computers in Mechanical Engineering, Orlando, Fla., 1 Aug. 1987 Prepared in cooperation with ORNL, Tenn.
(Contract DE-AC05-84OR-21400)
(DE88-003222; Y/CSD/INF-87/1; CONF-8708192-1) Avail: NTIS HC A02

Finite element analyses and computer aided design systems must often present graphical representations of three-dimensional parametric surfaces. Various algorithms were developed to describe color surfaces and to determine visibility. A procedure for using parametric interpolation to define such surfaces is presented. It is an extension of an earlier algorithm for defining contour lines on such surfaces. When applied on a raster scan color graphics device (or a line printer) the procedure allows the true representation of parametric surfaces. Surfaces can be presented in different colors. The intersection of surfaces is automatically included in the procedure for determining visibility. The algorithm can also be easily extended to allow color contour shading of values on the surface. DOE

N88-17322 Illinois Univ., Urbana-Champaign.
MULTIPLE-OBJECT MOTION ESTIMATION BY MAXIMAL MATCHING OF 3-D POINT AND LINE FEATURES Ph.D. Thesis
Homer Hong-Ming Chen [1987] 114 p
Avail: Univ. Microfilms Order No. DA8721605

Determining the relative motion between an observer and its environment is a major problem in computer vision. An approach to multiple-object motion estimation using 3-D data is presented. Algorithms are developed for matching 3-D point and line features of multiple grid objects. The point-matching algorithm determines

the correspondence by initiating a pairing of a triplet of noncollinear sensed points with a triplet of reference points and searching for new pairs of corresponding points, one at a time, using local distance and angular constraints. The pairing of each subsequent sensed point with a reference point is determined if the tetrahedron formed by the sensed point and the initial triplet is congruent to that formed by the corresponding reference points. Only simple computations are required in the matching. Global consistency of the pairings found by the algorithm is ensured without using model tests. The segment-matching algorithm consists of two stages. In the first stage, the point-matching algorithm serves as a basis to find orientationally consistent mappings. The translations are determined in the second stage by a clustering procedure. The translations are then used to prune the mappings generated in the first stage. The algorithms developed can easily be extended to incorporate other geometrical or nongeometrical object attributes to further prune the matchings. Results of running the algorithm on synthetic and real data are given. Dissert. Abstr.

N88-17323# Illinois Univ., Urbana. Center for Supercomputing Research and Development.
ACCELERATION TECHNIQUES FOR DECOUPLING ALGORITHMS IN SEMICONDUCTOR SIMULATION
T. Kerkhoven and Y. Saad Aug. 1987 20 p
(Contract DE-FG02-85ER-25001)
(DE88-003593; DOE/ER-25001/50; CSRD-686) Avail: NTIS HC A03/MF A01

Three techniques are proposed for accelerating the nonlinear block Gauss-Seidel algorithm for steady state semiconductor simulation: a second order stationary method, a Chebyshev acceleration and a nonlinear version of the generalized minimal residual algorithm (GMRES.) The parameters for the second order stationary method and the Chebyshev acceleration are obtained from the spectrum of the derivative of the fixed point mapping T defining the nonlinear algorithm. This spectrum is approximated by a matrix-free Arnoldi technique. The numerical results reported agree well with theoretical predictions. In particular, the nonlinear version of GMRES is found to be considerably more effective in accelerating the nonlinear map than the two second order recurrences. DOE

N88-17324# Illinois Univ., Urbana. Center for Supercomputing Research and Development.
A PARALLEL BLOCK CYCLIC REDUCTION ALGORITHM FOR THE FAST SOLUTION OF ELLIPTIC EQUATIONS
E. Gallopoulos and Y. Saad Apr. 1987 16 p Presented at the International Conference on Supercomputing, Athens, Greece, 8 Jun. 1987
(Contract DE-FG02-85ER-25001)
(DE88-003595; DOE/ER-25001/47; CONF-8706183-4; CSRD-659) Avail: NTIS HC A03/MF A01

This paper presents an adaptation of the Block Cyclic Reduction (BCR) algorithm for a multi-vector processor. The main bottleneck of BCR lies in the solution of linear systems whose coefficient matrix is the product of tridiagonal matrices. This bottleneck is handled by expressing the rational function corresponding to the inverse of this product as a sum of elementary fractions. As a result the solution of this system leads to parallel solutions of tridiagonal systems. Numerical experiments performed on an Alliant FX/8 are reported. DOE

N88-17325*# Sterling Federal Systems, Inc., Palo Alto, Calif.
MULTITASKING AND MICROTASKING EXPERIENCE ON THE NA S CRAY-2 AND ACF CRAY X-MP
Farhad Raiszadeh Jun. 1987 10 p
(Contract NAS2-11555)
(NASA-CR-177464; NAS 1.26:177464) Avail: NTIS HC A02/MF A01 CSCL 09B

The fast Fourier transform (FFT) kernel of the NAS benchmark program has been utilized to experiment with the multitasking library on the Cray-2 and Cray X-MP/48, and microtasking directives on the Cray X-MP. Some performance figures are shown, and the state of multitasking software is described. Author

N88-17326*# Virginia Univ., Charlottesville. Dept. of Computer Science.
THE IMPLEMENTATION AND USE OF Ada ON DISTRIBUTED SYSTEMS WITH HIGH RELIABILITY REQUIREMENTS Annual Progress Report, 1 Jan. 1987 - 14 Feb. 1988
J. C. Knight Mar. 1988 11 p
(Grant NAG1-260)
(NASA-CR-182481; NAS 1.26:182481; UVA528213-CS88-112)
Avail: NTIS HC A03/MF A01 CSCL 09B

The use and implementation of Ada were investigated in distributed environments in which reliability is the primary concern. In particular, the focus was on the possibility that a distributed system may be programmed entirely in Ada so that the individual tasks of the system are unconcerned with which processors are being executed, and that failures may occur in the software and underlying hardware. A secondary interest is in the performance of Ada systems and how that performance can be gauged reliably. Primary activities included: analysis of the original approach to recovery in distributed Ada programs using the Advanced Transport Operating System (ATOPS) example; review and assessment of the original approach which was found to be capable of improvement; development of a refined approach to recovery that was applied to the ATOPS example; and design and development of a performance assessment scheme for Ada programs based on a flexible user-driven benchmarking system. B.G.

N88-17211*# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. Dept. of Electrical and Computer Engineering.
DEVELOPMENT OF A COMPREHENSIVE SOFTWARE ENGINEERING ENVIRONMENT
Thomas C. Hartrum and Gary B. Lamont *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 31-38 (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 09B

N88-17212*# Inference Corp., Los Angeles, Calif.
SIMPLIFYING THE CONSTRUCTION OF DOMAIN-SPECIFIC AUTOMATIC PROGRAMMING SYSTEMS: THE NASA AUTOMATED SOFTWARE DEVELOPMENT WORKSTATION PROJECT
Bradley P. Allen and Peter L. Holtzman *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 39-44 (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 09B

N88-17213*# Rome Air Development Center, Griffiss AFB, N.Y. Command and Control Technology Div.
THE KNOWLEDGE-BASED SOFTWARE ASSISTANT
Kevin M. Benner and Douglas A. White *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 45-52 (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 09B

N88-17227*# Softech, Inc., Fairborn, Ohio.
THE IDEAL (INTEGRATED DESIGN AND ENGINEERING ANALYSIS LANGUAGES) MODELING METHODOLOGY: CAPABILITIES AND APPLICATIONS
Ken H. Evers and Robert F. Bachert (Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio.) *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 153-158 (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 09B

N88-17234*# Rockwell Shuttle Operations Co., Houston, Tex.
EXPERT SYSTEM VERIFICATION CONCERNS IN AN OPERATIONS ENVIRONMENT
Mary Ann Goodwin and Charles C. Robertson *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct.

1987 p 203-207 (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 09B

N88-17248*# Mitre Corp., Bedford, Mass.
TRIMODAL INTERPRETATION OF CONSTRAINTS FOR PLANNING
David Krieger and Richard Brown *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 307-313 Sponsored in part by NASA. Kennedy Space Center, and by Air Force (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 22B

N88-17253*# Systems Research and Applications, Inc., Arlington, Va.
SWAN: AN EXPERT SYSTEM WITH NATURAL LANGUAGE INTERFACE FOR TACTICAL AIR CAPABILITY ASSESSMENT
Robert M. Simmons *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 341-348 (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 09B

N88-17255*# National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.
THE KATE SHELL: AN IMPLEMENTATION OF MODEL-BASED CONTROL, MONITOR AND DIAGNOSIS
Matthew Cornell *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 355-360 (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 09B

N88-17261*# Michigan Univ., Ann Arbor. Robotics Research Lab.
SOFTWARE FOR INTEGRATED MANUFACTURING SYSTEMS, PART 1
A. W. Naylor and R. A. Volz *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 397-398 (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 09B

N88-17262*# Michigan Univ., Ann Arbor. Robotics Research Lab.
SOFTWARE FOR INTEGRATED MANUFACTURING SYSTEMS, PART 2
R. A. Volz and A. W. Naylor *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 399-403 (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 09B

N88-17263*# Michigan Univ., Ann Arbor. Real-Time Computing Lab.
COMMUNICATION AND CONTROL IN AN INTEGRATED MANUFACTURING SYSTEM
Kang G. Shin, Robert D. Throne, and Yogesh K. Muthuswamy *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 405-411 (For primary document see N88-17206 09-59)
(Contracts NCC-9-16; F33615-85-C-5105)
Avail: NTIS HC A23/MF A01 CSCL 09B

N88-17275*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
THE USE OF COMPUTER GRAPHIC SIMULATION IN THE DEVELOPMENT OF ROBOTIC SYSTEMS
Ken Fernandez *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas. First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 501-511 Previously announced in IAA as A87-15812 (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 09B

62 COMPUTER SYSTEMS

Includes computer networks and special application computer systems.

N88-17327# Massachusetts Inst. of Tech., Cambridge. Lab. for Computer Science.
A MULTITHREADED PROCESSOR ARCHITECTURE FOR PARALLEL SYMBOLIC COMPUTATION
Tetsuya Fujita Sep. 1987 74 p
(Contracts N00014-83-K-0125; N00014-84-K-0099)
(AD-A187034; MIT/LCS/TM-338) Avail: NTIS HC A04/MF A01 CSCL 09B

This paper describes the Multilisp Architecture for Symbolic Applications (MASA), which is a multithreaded processor architecture for parallel symbolic computation with various features intended for effective Multilisp program execution. The principal mechanisms exploited for this processor are multiple contexts, interleaved pipeline execution from separate instruction streams, and synchronization based on a bit in each memory cell. The tagged architecture approach is taken for Lisp program execution and trap conditions are provided for future object manipulation and garbage collection. GRA

N88-17328# Colorado Univ., Boulder. Dept. of Mathematics.
FEEDBACK STABILIZATION OF DISTRIBUTED SYSTEMS
Henry Hermes 1987 8 p
(Grant AF AFOSR-0198-86)
(AD-A187111; AFOSR-87-1559TR) Avail: NTIS HC A02/MF A01 CSCL 09B

This document considers stabilization (minimum time to the zero solution) of wave and beam equations via endpoint velocity control. In general it considers a control system described by a partial differential equation, with dependent variable denoted w=w(t,x), which admits V=curly d/curly d t as a symmetry generator and hence a conversation law which implies conversation of energy. GRA

N88-17329# Helsinki Univ. of Technology, Espoo (Finland). Dept. of Computer Science.
A TYPE-ORIENTED APPROACH TO KNOWLEDGED-BASED SYSTEMS Ph.D. Thesis
J. T. Bergqvist 1987 235 p Previously announced in IAA as A87-52097 Sponsored by the Nokia Corp.
(Ma-47; ISBN-951-666-243-9; ISSN-0355-2713; ETN-88-91659)
Avail: NTIS HC A11/MF A01

A type-oriented programming (TOP) approach to building knowledge-based problem solving systems is developed. A problem solving system is considered as a system of knowledge elements. Each knowledge element class consists of a set of knowledge items, possibly inherited along class structures. Elements and their items are given knowledge types. A knowledge type defines a knowledge representation and consists of a set of type aspects, possibly inherited along type structures. A knowledge type can be instantiated to give values to the aspects and, thus, to create a realization of a more general representation. Knowledge types are used when typed signals are sent to knowledge items or elements. In TOP, signals are processed by interpretations which are signal and receiver type-specific functions. Types can be active (operator), passive (value) or context creating (knowledge organizing) in nature. Using the TOP approach, a multilevel context architecture for modeling and solving problems of high knowledge intensity is proposed. ESA

N88-17330 National Physical Lab., Teddington (England). Div. of Information Technology and Computing.
A PROPOSAL FOR A FEASIBILITY STUDY ON THE DESIGN OF SOFTWARE INTERFACES IN LARGE SYSTEMS
B. A. Wichmann and P. T. Wilkinson Jun. 1987 21 p

(NPL-DITC-89/87; ISSN-0262-5369; ETN-88-91520) Copyright
Avail: Issuing Activity

A study of the nature, design, and evolution of software interfaces in large systems to reduce development costs and risks is proposed. Programming languages, prototyping, and data dictionaries are discussed. ESA

N88-17331 National Physical Lab., Teddington (England). Div. of Information Technology and Computing.
A CLASSIFIED BIBLIOGRAPHY ON PUBLICATIONS RELEVANT TO DATA SECURITY IN LANs
P. K. T. Vaswani Sep. 1987 18 p
(NPL-DITC-99/87; ISSN-0262-5369; ETN-88-91524) Copyright
Avail: Issuing Activity

Over 120 references on data security in local area networks, especially key management and authentication processes are listed. ESA

N88-17332# Royal Signals and Radar Establishment, Malvern (England).
AN APPROACH TO THE HIERARCHICAL SPECIFICATION, DESIGN AND VERIFICATION OF SOFTWARE
B. D. Bramson Jul. 1987 15 p
(RSRE-MEMO-4063; BR103381; ETN-88-91542) Copyright
Avail: NTIS HC A03/MF A01

A method for the production of large software systems via hierarchies of descriptive levels is proposed. The method is based on the simultaneous refinement of data and code, and guarantees conformity between different levels. It is illustrated using the MALPAS intermediate language. ESA

N88-17333*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
CONCEPT OF A PROGRAMMABLE MAINTENANCE PROCESSOR APPLICABLE TO MULTIPROCESSING SYSTEMS
Richard D. Glover Feb. 1988 74 p
(NASA-TM-100406; H-1425; NAS 1.15:100406) Avail: NTIS HC A04/MF A01 CSCL 09B

A programmable maintenance processor concept applicable to multiprocessing systems has been developed at the NASA Ames Research Center's Dryden Flight Research Facility. This stand-alone-processor is intended to provide support for system and application software testing as well as hardware diagnostics. An initial machanization has been incorporated into the extended aircraft interrogation and display system (XAIDS) which is multiprocessing general-purpose ground support equipment. The XAIDS maintenance processor has independent terminal and printer interfaces and a dedicated magnetic bubble memory that stores system test sequences entered from the terminal. This report describes the hardware and software embodied in this processor and shows a typical application in the check-out of a new XAIDS. Author

N88-17334# Illinois Univ., Urbana. Center for Supercomputing Research and Development.
THE EFFECTIVENESS OF CACHES AND DATA PREFETCH BUFFERS IN LARGE-SCALE SHARED MEMORY MULTIPROCESSORS Ph.D. Thesis
R. L. Lee May 1987 147 p
(Contract DE-FG02-85ER-25001)
(DE88-003594; DOE/ER-25001/49; UILU-ENG-87-8005; CSRD-670) Avail: NTIS HC A07/MF A01

Large shared memory multiprocessors usually have difficulty in matching the memory speed with the processor speed due to the large interconnection network between processors and shared memory. The effectiveness of caches and data prefetching by the processor in eliminating the memory access bottleneck is explored. Using trace driven simulations of numerical subroutines transformed into parallel form, the following multiprocessor characteristics are modeled in performance evaluation: the cost of a cache coherence enforcement scheme, the effect of a high degree of overlap between cache miss service, the cost of a pin limited data path between shared memory and caches, the effect of a high degree of data prefetching, the program behavior of a scientific workload as represented by over 20 numerical subroutines, and the parallel execution of programs. The optimal cache block size is examined in detail and it is found that a small cache block size is favored in the multiprocessors of interest. A compile-time cache coherence scheme allowing data to change cacheability is proposed and is shown to significantly perform better than schemes which do not allow cacheability changes. The relative effectiveness of caches and data prefetching is shown for a range of network delays and bandwidths and propose techniques to overcome some of the performance degradations due to read/write access to shared memory. DOE

N88-17335# Illinois Univ., Urbana. Center for Supercomputing Research and Development.
NONPREEMPTIVE RUN-TIME SCHEDULING ISSUES ON A MULTITASKED, MULTIPROGRAMMED MULTIPROCESSOR WITH DEPENDENCIES, BIDIMENSIONAL TASKS, FOLDING AND DYNAMIC GRAPHS Ph.D. Thesis
A. R. Miller May 1987 113 p
(Contract DE-FG02-85ER-25001)
(DE88-003598; DOE/ER-25001/45; UILU-ENG-87-8002; CSRD-656) Avail: NTIS HC A06/MF A01

Increases in high speed hardware have mandated studies in software techniques to exploit the parallel capabilities. The effects a run-time scheduler has on a multiprocessor are examined. The model consists of directed, acyclic graphs, generated from serial FORTRAN benchmark programs by the parallel compiler Parafrase. A multitasked, multiprogrammed environment is created. Dependencies are generated by the compiler. Tasks are bidimensional, i.e., they may specify both time and processor requests. Processor requests may be folded into execution time by the scheduler. The graphs may arrive at arbitrary time intervals. The general case is NP-hard, thus, a variety of heuristics is examined by a simulator. Multiprogramming demonstrates a greater need for a run-time scheduler than does monoprogramming for a variety of reasons, e.g., greater stress on the processors, a larger number of independent control paths, more variety in the task parameters, etc. The dynamic critical path series of algorithms performs well. Dynamic critical volume did not add much. Unfortunately, dynamic critical path maximizes turnaround time as well as throughput. Two schedulers are presented which balance throughput and turnaround time. The first requires classification of jobs by type; the second requires selection of a ratio value which is dependent upon system parameters. DOE

N88-16774# European Space Agency. European Space Operations Center, Darmstadt (West Germany). Computer Dept.
PARALLEL-PROCESSING COMPUTER SYSTEMS AND THEIR POSSIBLE APPLICATIONS IN THE AGENCY
M. Jones *In its* ESA Bulletin No. 25 Feb. 1981 p 60-65
(For primary document see N88-16767 09-12)
Avail: NTIS HC A05/MF A01

N88-17219*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
DEVELOPMENT AND EXPERIMENTATION OF AN EYE/BRAIN/TASK TESTBED
Nora Harrington (Analytics, Inc., Willow Grove, Pa.) and James Villarreal *In its* First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 93-95
(For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 09B

N88-17229*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
PERFORMANCE ANALYSIS OF PARALLEL BRANCH AND BOUND SEARCH WITH THE HYPERCUBE ARCHITECTURE
Richard T. Mraz *In its* First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 165-172
(For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 09B

N88-17230*# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. Dept. of Electrical and Computer Engineering.
TASK ALLOCATION IN A DISTRIBUTED COMPUTING SYSTEM
Walter D. Seward *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 173-181 (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 09B

N88-17259*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
IMPLEMENTING CLIPS ON A PARALLEL COMPUTER
Gary Riley *In its* First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 383-387 (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 09B

N88-17277*# California Univ., Santa Barbara. Dept. of Computer Science.
CALIBRATION OF NEURAL NETWORKS USING GENETIC ALGORITHMS, WITH APPLICATION TO OPTIMAL PATH PLANNING
Terence R. Smith, Gilbert A. Pitney, and Daniel Greenwood (Netrologic, Inc., San Diego, Calif.) *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 519-531 (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 09B

63 CYBERNETICS

Includes feedback and control theory, artificial intelligence, robotics and expert systems.

For related information see also *54 Man/System Technology and Life Support.*

N88-17336# Naval Postgraduate School, Monterey, Calif.
HORIZONTAL ESTIMATION AND INFORMATION FUSION IN MULTITARGET AND MULTISENSOR ENVIRONMENTS Ph.D. Thesis
Alaa E. Fahmy Sep. 1987 227 p
(AD-A186935) Avail: NTIS HC A11/MF A01 CSCL 09B

In recent years, there has been a considerable increase in both the variety and number of sensors which needed to be tied together. A new distributed estimation architecture for Distributed Sensors Networks (DSN) is introduced. It is called Horizontal Estimation Architecture (HEA). The term horizontal is used to imply that the geographically dispersed nodes do not differ in rank and are peer-to-peer coupled. Each node is connected by a data link to its neighbors (where possible), thus providing a mesh network topology. The introduced HEA has four major components, the local estimator, the information fusion process (both together are called a horizontal estimator), the network access protocol, and the controller-decisionmaker. The HEA techniques are applied to the solution of Multitarget and Multisensor Tracking (MMT) problems in Track-While-Scan (TWS) systems with an emphasis towards track fusion. A mathematical framework which encompasses the components of the horizontal estimator is developed, with an emphasis towards the track fusion algorithm. An artificial intelligence approach using expert systems for track fusion has been presented. Through this HEA application its main features and practical usefulness are addressed. GRA

N88-17337# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio.
MANAGEMENT OF COMPLEX INFORMATION IN SUPPORT OF EVOLVING AUTONOMOUS EXPERT SYSTEMS Final Report, Jan. 1983 - Mar. 1987
Eugenio Martinez Sep. 1987 75 p
(AD-A186680; AFWAL-TR-87-1123) Avail: NTIS HC A04/MF A01 CSCL 09B

Automata whose performance is dependent on specific information are referred to as expert systems. These effect and/or induce situations in the mission environment purposedly and as supported by their respective subdomains should be able and capable of evolving concurrently with and relative to an ever evolving mission environment. Information perceived from the latter may be complex, i.e., with multivariate, interrelated and dynamic patterns. The following addresses the problem of complex information management in support of autonomous expert systems within evolving environments. Emphasis is placed on the systems ability to infer generalizations, appraise the circumstantial states of the mission environment, and perform appropriate decision making. GRA

N88-17338# Rutgers - The State Univ., New Brunswick, N. J.
REGULATION OF NONLINEAR AND GENERALIZED LINEAR SYSTEMS Interim Technical Report, 15 Jul. 1986 - 14 Jul. 1987
Eduardo D. Sontag 14 Jul. 1987 9 p
(Grant AF-AFOSR-0247-85)
(AD-A186706; AFOSR-87-1394TR) Avail: NTIS HC A02/MF A01 CSCL 09B

This project concentrated on issues of nonlinear control design, with an emphasis on digital systems and symbolic methods. One area of effort was that of studying the effect of the use of sampling on the controllability and observability of nonlinear continuous systems as well as on recently developed linearization techniques. This is closely related to work on discrete-time controllability, also in progress under the grant. Another area dealt with a new method for automatic gain scheduling, for which a computerized design is now available. Experimental results are also described. GRA

N88-17339# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Operations Research and System Theory.
A STATE SPACE APPROACH TO THE PROBLEM OF ADAPTIVE POLE ASSIGNMENT
J. W. Poldermann Feb. 1987 29 p Submitted for publication
(CWI-OS-R8704; B8711096; ETN-88-91583) Copyright Avail: NTIS HC A03/MF A01

An algorithm for adaptive pole-placement for the class of single-input/single-output systems of order n is proposed. The asymptotic properties of the algorithm do not depend on persistently exciting signals. Excitation is used only initially to avoid pole-zero cancellation of the parameter estimates. The main result is that the asymptotic behavior of the system equals the behavior obtained on the basis of the true system. Identification of the system-parameters however, does not necessarily take place. The reason that such a result can be obtained without identification of the true system is the following: suppose a wrong estimate of the system of the system is used to generate the controls, and that the incorrectness of the estimate is not revealed by the resulting closed-loop behavior of the system, then the inputs are exactly equal to the ones which would be applied if the system was known. ESA

N88-17340# Royal Signals and Radar Establishment, Malvern (England).
EXPERIMENTS WITH THE BACK PROPAGATION ALGORITHM: A SYSTEMATIC LOOK AT A SMALL PROBLEM
M. D. Bedworth and J. S. Bridle 29 Jun. 1987 15 p
(RSRE-MEMO-4049; BR103851; ETN-88-91540) Copyright
Avail: NTIS HC A03/MF A01

The multi-layer perceptron is introduced. It is a type of feed forward neural network for which there exists a learning algorithm based on error back-propagation. Experimental results of the use of this error back-propagation algorithm on a simple problem (small, stochastic, discontinuous) are presented. The effects of varying the structure of the network, the number of hidden units, the size of the training set, and the initial weight values were investigated. Ways of analyzing solutions to such a simple problem are demonstrated. Explanations of the observed behavior which may

provide insights applicable to a range of problems are offered. ESA

N88-17341*# Massachusetts Inst. of Tech., Cambridge. Lab. for Information and Decision Systems.
A METHOD FOR DESIGNING ROBUST MULTIVARIABLE FEEDBACK SYSTEMS
David Albert Milich, Michael Athans, Lena Valavani, and Gunter Stein 1 Mar. 1988 27 p Presented at the 27th IEEE Conference on Decision and Control Submitted for publication
(Grant NAG2-297)
(NASA-CR-182459; NAS 1.26:182459; LIDS-P-1749) Avail: NTIS HC A03/MF A01 CSCL 09B

A new methodology is developed for the synthesis of linear, time-invariant (LTI) controllers for multivariable LTI systems. The aim is to achieve stability and performance robustness of the feedback system in the presence of multiple unstructured uncertainty blocks; i.e., to satisfy a frequency-domain inequality in terms of the structured singular value. The design technique is referred to as the Causality Recovery Methodology (CRM). Starting with an initial (nominally) stabilizing compensator, the CRM produces a closed-loop system whose performance-robustness is at least as good as, and hopefully superior to, that of the original design. The robustness improvement is obtained by solving an infinite-dimensional, convex optimization program. A finite-dimensional implementation of the CRM was developed, and it was applied to a multivariate design example. Author

N88-17342*# Massachusetts Inst. of Tech., Cambridge. Lab. for Information and Decision Systems.
A METHODOLOGY FOR THE SYNTHESIS OF ROBUST FEEDBACK SYSTEMS Ph.D. Thesis
David Albert Milich 1 Mar. 1988 198 p
(Grant NAG2-297)
(NASA-CR-182455; NAS 1.26:182455; LIDS-TH-1748) Avail: NTIS HC A09/MF A01 CSCL 09B

A new methodology is developed for the synthesis of linear, time-variant (LTI) controllers for multivariable LTI systems. The resulting closed-loop system is nominally stable and exhibits a known level of performance. In addition, robustness of the feedback system is guaranteed, i.e., stability and performance are retained in the presence of multiple unstructured uncertainty blocks located at various points in the feedback loop. The design technique is referred to as the Causality Recovery Methodology (CRM). The CRM relies on the Youla parameterization of all stabilizing compensators to ensure nominal stability of the feedback system. A frequency-domain inequality in terms of the structured singular value mu defines the robustness specification. The optimal compensator, with respect to the mu condition, is shown to be noncausal in general. The aim of the CRM is to find a stable, causal transfer function matrix that approximates the robustness characteristics of the optimal solution. The CRM, via a series of infinite-dimensional convex programs, produces a closed-loop system whose performance robustness is at least as good as that of any initial design. The algorithm is approximated by a finite dimensional process for the purposes of implementation. Two numerical examples confirm the potential viability of the CRM concept; however, the robustness improvement comes at the expense of increased computational burden and compensator complexity. Author

N88-17343# Oak Ridge National Lab., Tenn.
NAVIGATION PLANNING USING QUADTREES
R. C. Fryxell Nov. 1987 36 p
(Contract DE-AC05-84OR-21400)
(DE88-003706; ORNL/TM-10481; CESAR-87/20) Avail: NTIS HC A03/MF A01

An algorithm is presented for planning a 2-D collision-free path for a mobile robot in an unstructured work environment. The algorithm assumes the existence of a pixel map of all or part of the environment, where each pixel is either on (implying blocked) or off (implying clear). The goal is to compute a reasonable path between two points in a minimal amount of time, and this is achieved through a compressed representation of the pixel map using a modified quadtree data structure. The algorithm was coded in the C programming language, and the results of tests made on realistic indoor environments are presented. A discussion on how the environmental maps were obtained from sonar range-finder data is also included. DOE

N88-17218*# Air Force Systems Command, Wright-Patterson AFB, Ohio.
NEURAL NETWORK BASED ARCHITECTURES FOR AEROSPACE APPLICATIONS
Richard Ricart *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 85-91 (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 09B

N88-17220*# Netrologic, Inc., San Diego, Calif.
NASA JSC NEURAL NETWORK SURVEY RESULTS
Dan Greenwood *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 97-110 (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 09B

N88-17225*# Computer Sciences Corp., Houston, Tex. Applied Technology Div.
THE DESKTOP INTERFACE IN INTELLIGENT TUTORING SYSTEMS
Stephen Baudendistel and Grace Hua *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 135-143 (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 09B

N88-17228*# Rome Air Development Center, Griffiss AFB, N.Y.
COOPERATIVE ANALYSIS EXPERT SITUATION ASSESSMENT RESEARCH
Michael G. McCown *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 161-164 (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 09B

N88-17232*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
APPROACHES TO THE VERIFICATION OF RULE-BASED EXPERT SYSTEMS
Chris Culbert, Gary Riley, and Robert T. Savely *In its* First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 191-196 (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 09B

N88-17233*# Honeywell, Inc., Minneapolis, Minn. Systems and Research Center.
A FORMAL APPROACH TO VALIDATION AND VERIFICATION FOR KNOWLEDGE-BASED CONTROL SYSTEMS
Glen Castore *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 197-202 (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 09B

N88-17235*# Lockheed Missiles and Space Co., Austin, Tex. Artificial Intelligence Center.
BUILDING VALIDATION TOOLS FOR KNOWLEDGE-BASED SYSTEMS
R. A. Stachowitz, C. L. Chang, T. S. Stock, and J. B. Combs *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 209-216 (For primary document

see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 09B

N88-17236*# McDonnell-Douglas Astronautics Co., Houston, Tex. Engineering Services.
DIAGNOSIS: REASONING FROM FIRST PRINCIPLES AND EXPERIENTIAL KNOWLEDGE
Linda J. F. Williams and Dennis G. Lawler *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 217-222 (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 09B

N88-17238*# TRW, Inc., Redondo Beach, Calif.
TEACHING ARTIFICIAL NEURAL SYSTEMS TO DRIVE: MANUAL TRAINING TECHNIQUES FOR AUTONOMOUS SYSTEMS
J. F. Shepanski and S. A. Macy *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 231-238 (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 09B

N88-17243*# McDonnell-Douglas Astronautics Co., St. Louis, Mo.
THE EMPIRICAL ACCURACY OF UNCERTAIN INFERENCE MODELS
David S. Vaughan, Robert M. Yadrick, Bruce M. Perrin, and Ben P. Wise (Dartmouth Coll., Hanover, N.H.) *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 269-275 (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 09B

N88-17245*# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. Dept. of Operational Sciences.
ARTIFICIAL INTELLIGENCE (AI), OPERATIONS RESEARCH (OR), AND DECISION SUPPORT SYSTEMS (DSS): A CONCEPTUAL FRAMEWORK
Gregory S. Parnell, William F. Rowell, and John R. Valusek *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 287-292 (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 09B

N88-17246*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
ROBOTIC PLANNER EXPERT SYSTEM (RPLANES)
Ervin ONeal Grice *In its* First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 293-297 (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 09B

N88-17250*# Rome Air Development Center, Griffiss AFB, N.Y.
ADVANCED DECISION AIDING TECHNIQUES APPLICABLE TO SPACE
Robert J. Kruchten *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 321-326 (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 09B

N88-17251*# Systems Control Technology, Inc., Palo Alto, Calif.
AUTOMATIC ROUTING MODULE
Janice A. Malin *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 327-334 (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 09B

N88-17256*# Ford Aerospace and Communications Corp., Sunnyvale, Calif.
BEYOND RULES: THE NEXT GENERATION OF EXPERT SYSTEMS
Jay C. Ferguson and Robert E. Wagner *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 363-369 (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 09B

N88-17257*# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
A CONCEPTUAL FRAMEWORK FOR INTELLIGENT REAL-TIME INFORMATION PROCESSING
Robert Schudy *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 371-374 (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 09B

N88-17258*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
TDAS: THE THERMAL EXPERT SYSTEM (TEXSYS) DATA ACQUISITION SYSTEM
Edmund C. Hack (Lockheed Engineering and Management Services Co., Inc., Houston, Tex.) and Kathleen J. Healey *In its* First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 375-382 (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 09B

N88-17260*# Worcester Polytechnic Inst., Mass. Intelligent Machines Group.
REAL-TIME ARTIFICIAL INTELLIGENCE ISSUES IN THE DEVELOPMENT OF THE ADAPTIVE TACTICAL NAVIGATOR
Peter E. Green, Douglas P. Glasson, Jean-Michel L. Pomarede, and Narayan A. Acharya (Analytic Sciences Corp., Reading, Mass.) *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 389-396 (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 09B

N88-17278*# Texas Instruments, Inc., Dallas. Corporate Artificial Intelligence Lab.
AN EFFICIENT REPRESENTATION OF SPATIAL INFORMATION FOR EXPERT REASONING IN ROBOTIC VEHICLES
Steven Scott and Mark Interrante *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 527-531 (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 09B

N88-17279*# Mitre Corp., Houston, Tex.
TASK-LEVEL ROBOT PROGRAMMING: INTEGRAL PART OF EVOLUTION FROM TELEOPERATION TO AUTONOMY
James C. Reynolds *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 533-540 (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 09B

64 NUMERICAL ANALYSIS

Includes iteration, difference equations, and numerical approximation.

N88-17344# Clarkson Univ., Potsdam, N.Y. Div. of Research.
INTERDISCIPLINARY RESEARCH IN APPLIED MATHEMATICS Final Report, 15 Aug. 1986 - 14 Aug. 1987
Eytan Barouch 15 Jul. 1987 44 p
(Grant AF AFOSR-0249-86)

(AD-A186793; AFOSR-87-1204TR) Avail: NTIS HC A03/MF A01 CSCL 12A

The SUN system was ordered in September 1986. After long delays in production, the system was partially delivered in January to February 1987. The system was installed within two weeks and became functional in April to May 1987. Due to reduced amount of funds granted a supplementary fund was obtained from the National Science Foundation and Clarkson University has contributed as well. With these combined funds the system was made functional, after an ethernet installation. Several achievements can already be reported by the use of the SUN system despite its short service time. GRA

N88-17345# Duke Univ., Durham, N. C. Dept. of Computer Science.

A NOTE ON THE EFFECT OF PREEMPTIVE POLICIES ON THE STABILITY OF A PRIORITY QUEUE

Raymond Marie and Kishor S. Trivedi 1987 6 p

(Grant AF AFOSR-0132-84)

(AD-A186871; AFOSR-87-1515TR) Avail: NTIS HC A02/MF A01 CSCL 12A

We study the stability condition of an M/G/1 priority queue with two classes of jobs. Class 1 jobs have preemptive priority over class 2 jobs. We consider three different types of preemptions and the effects of possible work loss (due to preemption) on the stability condition for the queueing system. GRA

N88-17346# Naval Postgraduate School, Monterey, Calif.

AN ALGEBRAIC APPROACH TO A CALCULUS OF FUNCTIONAL DIFFERENCES: FIXED DIFFERENCES AND INTEGRALS

Bruce J. MacLennan Sep. 1987 33 p

(AD-A187079; NPS52-87-041) Avail: NTIS HC A03/MF A01 CSCL 12A

A notion of functional differences is introduced in which the difference of a function f with respect to a function h is that function g that describes how the value of f changes when its argument is altered by h: f(h(x)) = g(f(x)). The author introduces the inverse operation of functional integration and derives useful properties of both operations. The result is a calculus that facilitates derivation and reasoning about recursive programs. This is illustrated in a number of simple examples. The present report uses algebraic methods to establish preliminary results pertaining to fixed differences, that is, functional differences that do not depend on the value of the argument x. GRA

N88-17347# New York Univ., New York. Inst. of Mathematical Sciences.

TECHNIQUES IN LINEAR AND NONLINEAR PARTIAL DIFFERENTIAL EQUATIONS Final Technical Report, 23 Jul. 1984 - 22 Jul. 1987

Louis Nirenberg 14 Sep. 1987 2 p

(Contract DAAG29-84-K-0150)

(AD-A187109; Rept-5274286; ARO-21565.5-MA) Avail: NTIS HC A02/MF A01 CSCL 12A

Much work has been done, especially for nonlinear, involving new a priori estimates, variational methods and Brownian motion. The author and collaborators have written a series of papers on fully nonlinear elliptic equations - involving new a priori estimates. GRA

N88-17348# Georgetown Univ., Washington, D.C. Dept. of Mathematics.

NOTE ON BOUNDARY STABILIZATION OF WAVE EQUATIONS

John E. Lagnese 1986 10 p

(Grant AF AFOSR-0162-86)

(AD-A187113; AFOSR-87-1560TR) Avail: NTIS HC A02/MF A01 CSCL 12A

An energy decay rate is obtained for solutions of wave type equations in a bounded region in R superscript n whose boundary consists partly of a nontrapping reflecting surface and partly of an energy absorbing surface. Unlike most previous results on this problem, the results presented here are valid for regions having connected boundaries. GRA

N88-17349# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Systems and Logistics.

A COMPARISON OF FITTING TECHNIQUES FOR THE CUMULATIVE AVERAGE LEARNING CURVES WITH HISTORICAL LOT COST DATA M.S. Thesis

John K. Jones Sep. 1987 214 p

(AD-A187127; AFIT/GSM/LSQ/87S-11) Avail: NTIS HC A10/MF A01 CSCL 12A

The technique used to fit cost data to the cumulative average learning curve can have an impact on the accuracy of the estimates provided. This research tested two specific fitting techniques, the elementary technique (ET) and the Calot technique, in an attempt to determine which technique provides the greater accuracy when used to fit historical lot cost data to the cumulative average learning curve. Both techniques were evaluated on there ability to fit total lot costs and predict last lot costs. The ET and Calot fitting techniques were both used to fit the historical lot costs for 66 systems to the cumulative average learning curve. A comparison of the two techniques indicates that Calot estimates total lot costs with greater accuracy more frequently and with a significantly lower standard error then the ET technique. Calot also demonstrated the ability to estimate the last lot costs more accurately more frequently than 50 percent of the time. GRA

N88-17350# Lawrence Livermore National Lab., Calif.

SOME PROPERTIES OF THE HILBERT TRANSFORM

Dennis M. Goodman Nov. 1987 5 p Presented at the 21st Annual Asilomar Conference on Signals, Systems, and Computers, Pacific Grove, Calif., 2 Nov. 1987

(Contract W-7405-eng-48)

(DE88-002465; UCRL-97609; CONF-871162-3) Avail: NTIS HC A02/MF A01

The derivatives of the operation of stabilizing a multidimensional sequence are calculated. This calculation is based on the Frechet derivative and some properties of the cepstrum. The implications for the design of recursive filters are discussed. These results may also be useful in the one-dimensional case. DOE

N88-17351# Washington State Univ., Pullman. Dept. of Pure and Applied Mathematics.

ON LINE SEARCH TERMINATION CRITERIA FOR AND CONVERGENCE OF CONIC ALGORITHMS FOR MINIMIZATION

K. A. Ariyawansa 1986 3 p Presented at the 24th Annual Allerton Conference on Communication, Control and Computing, Monticello, Ill., 1 Oct. 1986

(Contract DE-FG06-85ER-25007)

(DE88-002844; CONF-8610302-1) Avail: NTIS HC A02/MF A01

This report presents an implementable class of collinear scaling algorithms for unconstrained minimization. A member of this class that extends the BFGS method does possess desirable properties similar to those shown for the BFGS method by Powell (1976). However, a major drawback is that in order to guarantee q-superlinear convergence, a parameter in the algorithm must be set to a value which depends on F. DOE

N88-17352# North Carolina Univ., Chapel Hill. Dept. of Statistics.

A NOTE ON COMPUTING ROBUST REGRESSION ESTIMATES VIA ITERATIVELY REWEIGHTED LEAST SQUARES Journal Article, Aug. 1986 - Aug. 1987

Raymond J. Carroll, David Ruppert, and James O. Street (Boehringer Ingelheim Pharmaceuticals, Ridgefield, Conn.) Feb. 1987 14 p

(Contract F49620-85-C-0144; Grant NSF MCS-81-00748)

(AD-A186709; MIMEO SER-1714; AFOSR-87-1097TR) Avail: NTIS HC A02/MF A01 CSCL 12A

Statistics provides a method for computing robust regression estimates using iterative reweighted least squares and the nonlinear regression procedure NLIN. While the estimates are asymptotically

correct, the resulting standard errors are not. Computation of the estimates are discussed. GRA

N88-17353# Wayne State Univ., Detroit, Mich.
OPTIMAL CORRECTION PROBLEM OF A MULTIDIMENSIONAL STOCHASTIC SYSTEM
J. L. Menaldi and M. I. Taksar Sep. 1987 29 p
(Grants AF-AFOSR-0278-87; NSF DMS-86-01998)
(AD-A186727; AFOSR-87-1479TR) Avail: NTIS HC A03/MF A01 CSCL 12A

We consider a stochastic dynamic system which is governed by a multidimensional diffusion process with constant drift and diffusion coefficients. The correction corresponds to an additive input which is under control. There is no limit on the rate of input into the system. The objective is to minimize the expected cumulative cost associated with the position of the system and the amount of control exerted. It is proved that Hamilton-Jacobi-Bellman's equation of the problem has a solution, which corresponds to the optimal cost of the problem. An existence of optimal policy is proved. GRA

N88-17354# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Applied Mathematics.
BOUNDARY VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATIONS WITH MULTIPLE TURNING POINTS
Furu Jiang Jan. 1987 13 p
(CWI-AM-R8701; B8709685; ETN-88-91567) Copyright Avail: NTIS HC A03/MF A01

Boundary value problems for ordinary differential equations with multiple turning points are considered by means of the method of multiple scales. The uniformly valid asymptotic expansions of solutions are constructed for resonant and nonresonant cases under certain conditions. ESA

N88-17355# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Numerical Mathematics.
EXPLICIT-IMPLICIT METHODS FOR TIME-DEPENDENT PARTIAL DIFFERENTIAL EQUATIONS
E. D. deGoede and F. W. Wubs Feb. 1987 25 p Submitted for publication Sponsored in part by the Netherlands Foundation for Technical Research
(CWI-NM-R8703; B8711198; ETN-88-91571) Copyright Avail: NTIS HC A03/MF A01

For the integration of partial differential equations explicit and implicit integrators are distinguished. Implicit methods allow large integration steps, but require more storage and are more difficult to implement than explicit methods. However, explicit methods are subject to a restriction on the integration step. Explicit-implicit methods, which combine explicit and implicit calculations are introduced. For these methods, the impact of varying the explicitness, and thus the implicitness, on the stability is examined. ESA

N88-17356# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Numerical Mathematics.
DIAGONALLY IMPLICIT RUNGE-KUTTA-NYSTROM METHODS FOR OSCILLATORY PROBLEMS
P. J. vanderHouwen and B. P. Sommeijer Mar. 1987 20 p
(CWI-NM-R8704; B8711199; ETN-88-91572) Copyright Avail: NTIS HC A03/MF A01

Implicit Runge-Kutta-Nystrom (RKN) methods for the integration of second-order differential equations possessing an oscillatory solution are constructed. A linear homogeneous test model is used to analyze phase errors (or dispersion) introduced by these methods and derive so-called dispersion relations. Diagonally implicit RKN methods of relatively low algebraic order which have a high-order of dispersion (up to 10) are constructed. Application of these methods to test examples (iinear as well as nonlinear) yields a greatly reduced phase error compared with conventional methods. ESA

N88-17357# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Numerical Mathematics.
ANALYSIS OF SMOOTHING MATRICES FOR THE PRECONDITIONING OF ELLIPTIC DIFFERENCE EQUATIONS
P. J. vanderHouwen, C. Boon, and F. W. Wubs Mar. 1987 16 p Sponsored in part by the Netherlands Foundation for Technical Research
(CWI-NM-R8705; B8711200; ETN-88-91573) Copyright Avail: NTIS HC A03/MF A01

It is suggested that smoothing techniques similar to those used for stabilizing explicit time integration of parabolic and hyperbolic initial-boundary value problems can be used for the preconditioning of elliptic difference equations. It is shown that the spectral radius of the Jacobian matrix associated with the system of equations can be reduced considerably by this type of preconditioner, without much computational effort. Theoretically, this results in a much more rapid convergence of function iteration methods like the Jacobi type methods. The use of smoothing techniques is illustrated for one-dimensional and two-dimensional linear and nonlinear problems. Numerical results show that the use of rather simple smoothing matrices reduce the number of iterations by a least a factor 10. ESA

N88-17358# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Numerical Mathematics.
A NOTE ON A DIAGONALLY IMPLICIT RUNGE-KUTTA-NYSTROM METHOD
B. P. Sommeijer Feb. 1987 7 p
(CWI-NM-R8706; B8711201; ETN-88-91574) Copyright Avail: NTIS HC A02/MF A01

It is shown that it is possible to obtain fourth-order accurate diagonally implicit Runge-Kutta-Nystrom methods with only two stages. The scheme with the largest interval of periodicity, i.e., (0,12), is given. The requirement of P-stability decreases the order to two. ESA

N88-17359# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Numerical Mathematics.
IMPROVING THE STABILITY OF PREDICTOR-CORRECTOR METHODS BY RESIDUE SMOOTHING
P. J. vanderHouwen and B. P. Sommeijer Feb. 1987 18 p
(CWI-NM-R8707; B8711202; ETN-88-91575) Copyright Avail: NTIS HC A03/MF A01

It is shown that residue smoothing can be used to increase the stability region of predictor-corrector methods by increasing the real stability boundary. The iteration parameters and the smoothing operators are choosen such that the stability boundary becomes as large as (cm,q) m sq 4 to the q-th power when m is the number of right-hand side evaluations per step, q the number of smoothing operations applied to each right-hand side evaluation, and c(m,q) a slowly varying function of m and q, of magnitude 1.3 in a typical case. Numerical results show that, for a variety of linear and nonlinear parabolic equations in one and two spatial dimensions, these smoothed predictor-corrector methods are at least competitive with conventional implicit methods. ESA

N88-17360# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Numerical Mathematics.
STABILITY RESULTS FOR THETA METHODS APPLIED TO A CLASS OF STIFF DIFFERENTIAL-ALGEBRAIC EQUATIONS
W. H. Hundsdorfer Apr. 1987 13 p
(CWI-NM-R8708; B8717213; ETN-88-91576) Copyright Avail: NTIS HC A03/MF A01

Simple numerical methods for a class of stiff differential-algebraic equations (with index 2) are considered. The methods are based on the theta method for ordinary differential equations. The stability and convergence properties of the methods are discussed. ESA

N88-17361# Technische Hochschule, Darmstadt (West Germany). Fachbereich Mathematik.
DEVELOPMENTS RELATED TO SCATTERING EIGEN ELEMENTS IN SCHROEDINGER OPERATORS FOR PARTICLES WITH SPIN Ph.D. Thesis [ENTWICKLUNGEN NACH STREUEIGENELEMENTEN BEI SCHROEDINGER-OPERATOREN FUER TEILCHEN MIT SPIN]
Siamak Minutschehr 1986 126 p In GERMAN
(ETN-88-91077) Avail: NTIS HC A07/MF A01

It was investigated under which conditions for the functions appearing in the Schroedinger operator, the operator has a complete system of scattering eigen elements. These elements are characterized by asymptotic conditions. The characteristics of operator and scattering eigen elements are explained. The conditions for a complete system of scattering eigen elements were deduced using a modified method of Alsholm and Schmidt; under these conditions complete wave operators also exist. ESA

N88-17362# Technische Hochschule, Darmstadt (West Germany). Fachbereich Mathematik.
THEORY OF THE GENERALIZED ABEL INTEGRAL EQUATIONS Ph.D. Thesis [ZUR THEORIE VERALLGEMEINERTER ABELSCHER INTEGRALGLEICHUNGEN]
Frank Penzel 1986 68 p In GERMAN
(ETN-88-91086) Avail: NTIS HC A04/MF A01

Abel integral equations were solved using weighted operators that can be treated with Mellin transforms. Generalized Abel integral equations in elasticity theory problems were emphasized. This method allows the reduction of many proofs to known properties of Mellin transforms. Systems of generalized Abel integral equations were reduced to Riemann boundary value problems. The equivalence between Abel integral equations and scalar Riemann boundary value problems, as well as between Abel integral equations and singular integral equations are discussed. Fredholm operators, and examples are presented. ESA

N88-17363# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Abteilung Hubschrauber und Flugzeuge.
REDUCTION OF TIME DELAYS IN RUNGE-KUTTA INTEGRATION METHODS
S. Nowack and Feil 15 Apr. 1986 20 p
(MBB/LKE-132/S/PUB/241/A; ETN-88-91438) Copyright
Avail: NTIS HC A03/MF A01

A fourth order accurate Runge-Kutta (RK4) method for real time system simulation is proposed, where data must be sampled from input signals and incorporated into the numerical integration algorithms in order to evaluate the derivatives of the state variables. The method is compared to a standard RK4 for a flight simulation. Simulation of a one DOF-system with varying damping ratios shows that the accuracy of the proposed routine is equal (in the case of constant input function) or slightly superior (in the case of sinusoidal input) to the RK4 standard method. The results are for a system requiring no extrapolation. Simulation of a complex real time system (approach and touchdown of aircraft) shows that the proposed routine provides an increase in accuracy over the RK4 standard method even beyond decreasing the size of steps in output signals. This is particularly important when system variables change with high frequency and large increments. ESA

N88-17364 National Physical Lab., Teddington (England). Div. of Information Technology and Computing.
FITTING A GENERALIZED PARABOLA TO DATA
Alistair B. Forbes Sep. 1987 26 p
(NPL-DITC-96/87; ISSN-0262-5369; ETN-88-91521) Copyright
Avail: Issuing Activity

The problem of fitting a generalized parabola to data is modeled as a four parameter nonlinear least squares problem, with two of the parameters appearing linearly. It is shown that eliminating these two parameters leads to an increase in the numerical stability of the model. The performance of a Gauss-Newton type algorithm applied to the four and two parameters models is assessed. Numerical results demonstrate that the parameter elimination leads to a more robust and efficient algorithm. ESA

N88-17365 National Physical Lab., Teddington (England). Div. of Information Technology and Computing.
FINITE ELEMENT MESH GENERATION AND ISOPARAMETRIC ELEMENTS
S. A. Hannaby Aug. 1987 18 p
(NPL-DITC-97/87; ISSN-0262-5369; ETN-88-91522) Copyright
Avail: Issuing Activity

Akin's (1982) finite element mesh generation method is reviewed. The method involves the solution of Laplace's equation in a rectangle to map it onto a more complex domain of interest, i.e., the Laplace mapping method. In the more complex domain, elements vary in shape and size, requiring stiffness matrices for irregular elements. The so-called isoparametric approach, in which an irregular element is mapped onto a standard element by means of the same basis functions as are used in the finite element approximation, is adopted. The isoparametric element stiffness matrix for Poisson's equation and a linear triangular element are derived. A major limitation of the Laplace mapping method, and an example in which it occurs, are shown. A modification to overcome this limitation is suggested. ESA

N88-17366 National Physical Lab., Teddington (England). Div. of Information Technology and Computing.
STRATEGIES FOR KNOT PLACEMENT IN LEAST SQUARES DATA FITTING BY SPLINES
M. G. Cox, P. M. Harris, and Helen M. Jones Sep. 1987 52 p
(NPL-DITC-101/87; ISSN-0262-5369; ETN-88-91525) Copyright
Avail: Issuing Activity

The use of univariate spline functions in fitting noisy data by the least squares method is considered. When defining the space of approximating functions from which the fit is to be taken, there is freedom in the number and locations of the interior knots. The distribution of these knots can have a profound impact on the effectiveness of the spline in approximating the data. Strategies for the automatic placement of these knots are treated. Ways of finding good knots relatively cheaply are emphasized. Strategies are divided into those which produce a single knot set and those, adaptive in nature, which use information obtained from the spline fit based on current knots to update that knot set. Algorithms are discussed. ESA

N88-17367 National Physical Lab., Teddington (England). Div. of Information Technology and Computing.
ADVANCES IN RELIABLE NUMERICAL COMPUTATION: A SUMMARY
M. G. Cox Sep. 1987 17 p Meeting held in Teddyington, United Kingdom, 8-10 Jul. 1987
(NPL-DITC-102/87; ISSN-0262-5369; ETN-88-91526) Copyright
Avail: Issuing Activity

Numerical computation aspects of linear algebra, error analysis, computer arithmetic, algorithms, and mathematical software were discussed. ESA

N88-17368# Royal Aircraft Establishment, Farnborough (England).
SOLUTION OF THE HYPERBOLIC KEPLER'S EQUATION
R. H. Gooding Jun. 1987 47 p
(RAE-TR-87042; RAE-SPACE-668; BR103707; ETN-88-91535)
Copyright Avail: NTIS HC A03/MF A01

Three procedures for solving the Kepler equation for hyperbolic orbits were developed. Each procedure operates by a fourth-order convergence process, and uses a fixed number of iterations to produce an accuracy (relative) always better than 10 to the minus 13th power. The first procedure uses a starting formula for H (the hyperbolic eccentric anomaly) similar to a starter developed for elliptic orbits, but with three iterations required. The second procedure uses a more accurate starter, such that two iterations always suffice, and the pros and cons of the corresponding procedure for the elliptic equation are noted. The third procedure is based on a reformulation of the standard hyperbolic equation, so that a different quantity (sinh H rather than H) is determined. The advantages of the reformulation make this procedure the best

of the three. A procedure for solving the elliptic equation is presented. ESA

N88-17369# Helsinki Univ. (Finland). Inst. of Mechanics.
PERTURBATION THEORY FOR DUAL SEMIGROUPS 2. TIME-DEPENDENT PERTURBATIONS IN THE SUN-REFLEXIVE CASE
P. Clement, O. Diekmann, M. Gyllenberg, H. J. A. M. Heijmans, and H. R. Thieme 1987 60 p
(PB88-113097; Rept-24; ISBN-951-754-142-2) Avail: NTIS HC A04/MF A01 CSCL 12A

Time-dependent perturbations of generators on strongly continuous semigroups on a Banach space are considered. The perturbations map the Banach space into a bigger space, which is the second dual of the original space in a specific semigroup sense. Using the theory of dual semigroups, it is shown that the solutions of a generalized variation-of-constants formula define an evolutionary system. Continuity and differentiability properties of the evolutionary system were investigated and examined in what sense the perturbed generator and its adjoint generate these evolutionary systems. It is shown that the results apply naturally to retarded functional differential equations and age structured population dynamics. GRA

N88-17370*# Illinois State Water Survey, Champaign. Climate and Meteorology Section.
MODIFICATION OF A SUCCESSIVE CORRECTIONS OBJECTIVE ANALYSIS FOR IMPROVED HIGHER ORDER CALCULATIONS Status Report
Gary L. Achtemeier 25 Feb. 1988 28 p
(Grant NAG8-059)
(NASA-CR-182467; NAS 1.26:182467) Avail: NTIS HC A03/MF A01 CSCL 12A

The use of objectively analyzed fields of meteorological data for the initialization of numerical prediction models and for complex diagnostic studies places the requirements upon the objective method that derivatives of the gridded fields be accurate and free from interpolation error. A modification was proposed for an objective analysis developed by Barnes that provides improvements in analysis of both the field and its derivatives. Theoretical comparisons, comparisons between analyses of analytical monochromatic waves, and comparisons between analyses of actual weather data are used to show the potential of the new method. The new method restores more of the amplitudes of desired wavelengths while simultaneously filtering more of the amplitudes of undesired wavelengths. These results also hold for the first and second derivatives calculated from the gridded fields. Greatest improvements were for the Laplacian of the height field; the new method reduced the variance of undesirable very short wavelengths by 72 percent. Other improvements were found in the divergence of the gridded wind field and near the boundaries of the field of data. Author

N88-17371# University of Northern Illinois, De Kalb. Dept. of Mathematical Sciences.
NORM INEQUALITIES FOR DERIVATIVES AND DIFFERENCES
Man Kam Kwong and A. Zettl 1987 32 p Presented at the International Conference on Inequalities, Birmingham, United Kingdom, 13 Jul. 1987 Prepared in cooperation with Argonne National Lab., Ill.
(Contract W-31-109-eng-38)
(DE88-002920; CONF-8707135-1) Avail: NTIS HC A03/MF A01

Norm inequalities of product form relating a function and two of its derivatives and a sequence and two of its differences are discussed and compared. This paper contains a discussion of the possible values of the p and q norms of a function y and its n(sup th) derivative y(sup (n)). Detailed elementary proofs of the basic inequality for functions and a number of related inequalities are also given. A discussion of the growth at infinity of derivatives and a summary of cases when the best constant is known explicitly for both the continuous and the discrete versions of the basic inequality are also discussed. DOE

N88-17372# Argonne National Lab., Ill.
PRECONDITIONED ITERATIVE METHODS FOR PARTIAL DIFFERENTIAL EQUATIONS
G. K. Leaf, M. Minkoff, and J. C. Diaz 1987 6 p Presented at the 6th IMACS International Symposium on Computer Methods for Partial Differential Equations, Bethlehem, Pa., 23 Jun. 1987 Prepared in cooperation with Oklahoma Univ., Norman
(Contract W-31-109-eng-38)
(DE88-003071; CONF-870677-11) Avail: NTIS HC A02

Preconditioners and iterative methods are considered to solve the linear algebraic system associated with a partial differential equation. Interest stems from earlier work in solving kinetics diffusion equations and a recognition that the solution of the underlying linear system at each timestep is crucial in terms of computational storage and time. There is interest in developing an approach to handle nonsymmetric matrices so that convective terms in the partial differential equation (PDE) can be dealt with. A model problem is considered which has been used in related work. With regard to the approach there are two aspects: the preconditioner and the iterative method. Among the former considered are normal form LU factorization and variations related to approximate inverses. The iterative methods include normal form conjugate gradients and related nonsymmetric methods (ORTHOMIN and ORTHODIR). The use of either an approximate LU factorization or an approximate inverse in combination with normal form conjugate gradient iteration provides an effective approach for solving the model problem, suggesting potential use of approximate inverses for parallel computation. DOE

N88-17373# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR).
ON EXACT SOLUTIONS OF MULTIDIMENSIONAL SCHROEDINGER EQUATION WITH POLYNOMIAL POTENTIALS
A. V. Turbiner and A. G. Ushveridze 1986 8 p
(DE88-700460; ITEP-169-1986) Avail: NTIS (US Sales Only) HC A02/MF A01

Three classes of exact solutions for the discrete spectrum of the two-dimensional Schroedinger equation with special polynomial potentials are constructed. Various types of the node surfaces in wave functions are found. It is shown that there are some node surfaces which do not change under variations of the asymmetry parameter of the potential. Multidimensional case is discussed in brief. DOE

N88-17374# Argonne National Lab., Ill.
NUMERICAL SOLUTIONS OF TWO MOVING BOUNDARY PROBLEMS BY BOTH FINITE DIFFERENCE AND FINITE ELEMENT METHODS WITH APPLICATIONS
A. M. Hassanein 1987 15 p Presented at the 12th International Conference on Atomic Collisions in Solids, Okayama, Japan, 12 Oct. 1987
(Contract W-31-109-eng-38)
(DE88-002867; CONF-8710159-4) Avail: NTIS HC A03/MF A01

The time dependent heat conduction equation that is solved in different coordinate systems is solved subject to various boundary conditions. Boundary conditions include surface heat flux, energy to vaporization of target materials, radiation from surface to surrounding, and possible phase change of material. This system of equations is subject to two moving boundaries. One moving boundary being the melt-solid interface because the surface heat flux may result in melting the surface of the exposed material. Another moving boundary is the receding surface as a result of evaporation of the wall material due to the continuous heating of the melted surface. Finite difference and the finite element methods are used and compared in such solution to these problems. Physical applications to these problems include high energy deposition from electron or ion beams interaction with materials for space and weapons applications, plasma disruption and energy dump on the walls or components of a fusion reactor, and high energy laser welding and annealing of materials. DOE

N88-17375# Cranfield Inst. of Tech., Bedford (England). Dept. of Aerodynamics.
A FAST RIEMANN SOLVER WITH CONSTANT COVOLUME APPLIED TO THE RANDOM CHOICE METHOD
E. F. Toro Oct. 1987 40 p
(CAR-8719; ISBN-0-947767-81-9) Avail: NTIS HC A03/MF A01

The Riemann problem for the unsteady, 1-dimensional Euler equations together with the constant-covolume equation of state is solved exactly. The solution is then applied to the Random Choice Method to solve the general initial-boundary value problem for the Euler equations. The iterative procedure to find p*, the pressure between the acoustic waves, involves a single algebraic (nonlinear) equation, all other quantities follow directly throughout the x-t plane, except within rarefaction fans, where an extra iterative procedure is required. Author

N88-17376*# New Orleans Univ., La. Dept. of Physics.
OPTIMAL APPLICATION OF MORRISON'S ITERATIVE NOISE REMOVAL FOR DECONVOLUTION. APPENDICES Final Report
George E. Ioup and Juliette W. Ioup 30 Nov. 1987 1078 p
(Grant NAG1-485)
(NASA-CR-182477; NAS 1.26:182477) Avail: NTIS HC A99/MF E04 CSCL 12A

Morrison's iterative method of noise removal, or Morrison's smoothing, is applied in a simulation to noise-added data sets of various noise levels to determine its optimum use. Morrison's smoothing is applied for noise removal alone, and for noise removal prior to deconvolution. For the latter, an accurate method is analyzed to provide confidence in the optimization. The method consists of convolving the data with an inverse filter calculated by taking the inverse discrete Fourier transform of the reciprocal of the transform of the response of the system. Various length filters are calculated for the narrow and wide Gaussian response functions used. Deconvolution of non-noisy data is performed, and the error in each deconvolution calculated. Plots are produced of error versus filter length; and from these plots the most accurate length filters determined. The statistical methodologies employed in the optimizations of Morrison's method are similar. A typical peak-type input is selected and convolved with the two response functions to produce the data sets to be analyzed. Both constant and ordinate-dependent Gaussian distributed noise is added to the data, where the noise levels of the data are characterized by their signal-to-noise ratios. The error measures employed in the optimizations are the L1 and L2 norms. Results of the optimizations for both Gaussians, both noise types, and both norms include figures of optimum iteration number and error improvement versus signal-to-noise ratio, and tables of results. The statistical variation of all quantities considered is also given. Author

N88-17377*# Texas Univ., Dallas.
APPLICATIONS OF NONLINEAR SYSTEMS THEORY TO CONTROL DESIGN
L. R. Hunt and Ramiro Villarreal [1988] 8 p
(Grant NAG2-366)
(NASA-CR-182485; NAS 1.26:182485) Avail: NTIS HC A02/MF A01 CSCL 12A

For most applications in the control area, the standard practice is to approximate a nonlinear mathematical model by a linear system. Since the feedback linearizable systems contain linear systems as a subclass, the procedure of approximating a nonlinear system by a feedback linearizable one is examined. Because many physical plants (e.g., aircraft at the NASA Ames Research Center) have mathematical models which are close to feedback linearizable systems, such approximations are certainly justified. Results and techniques are introduced for measuring the gap between the model and its truncated linearizable part. The topic of pure feedback systems is important to the study. Author

N88-17378*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
ANALYSIS OF THE SPECTRAL VANISHING VISCOSITY METHOD FOR PERIODIC CONSERVATION LAWS Final Report
Yvon Maday and Eitan Tadmor (Tel-Aviv Univ., Israel) Jan. 1988 37 p Submitted for publication
(Contracts NAS1-18107; DAAG85-K-0190; Grants BSF 85-00346; NSF DMS-85-03294)
(NASA-CR-181613; ICASE-88-4; NAS 1.26:181613) Avail: NTIS HC A03/MF A01 CSCL 12A

The convergence of the spectral vanishing method for both the spectral and pseudospectral discretizations of the inviscid Burgers' equation is analyzed. It is proven that this kind of vanishing viscosity is responsible for a spectral decay of those Fourier coefficients located toward the end of the computed spectrum; consequently, the discretization error is shown to be spectrally small independent of whether the underlying solution is smooth or not. This in turn implies that the numerical solution remains uniformly bounded and convergence follows by compensated compactness arguments. Author

N88-17379*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
COUPLING FINITE ELEMENT AND SPECTRAL METHODS: FIRST RESULTS Final Report
Christine Bernardi, Naima Debit, and Yvon Maday (Paris VI Univ., France) Nov. 1987 46 p Submitted for publication
(Contract NAS1-18107)
(NASA-CR-181606; ICASE-87-70; NAS 1.26:181606) Avail: NTIS HC A03/MF A01 CSCL 12A

A Poisson equation on a rectangular domain is solved by coupling two methods: the domain is divided in two squares, a finite element approximation is used on the first square and a spectral discretization is used on the second one. Two kinds of matching conditions on the interface are presented and compared. In both cases, error estimates are proved. Author

65 STATISTICS AND PROBABILITY

Includes data sampling and smoothing; Monte Carlo method; and stochastic processes.

N88-17380*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
SURE RELIABILITY ANALYSIS: PROGRAM AND MATHEMATICS
Ricky W. Butler and Allan L. White Mar. 1988 77 p
(NASA-TP-2764; L-16263; NAS 1.60:2764) Avail: NTIS HC A05/MF A01 CSCL 12A

The SURE program is a new reliability analysis tool for ultrareliable computer system architectures. The computational methods on which the program is based provide an efficient means for computing accurate upper and lower bounds for the death state probabilities of a large class of semi-Markov models. Once a semi-Markov model is described using a simple input language, the SURE program automatically computes the upper and lower bounds on the probability of system failure. A parameter of the model can be specified as a variable over a range of values directing the SURE program to perform a sensitivity analysis automatically. This feature, along with the speed of the program, makes it especially useful as a design tool. Author

N88-17381# Naval Postgraduate School, Monterey, Calif.
PRACTICAL APPLICABILITY OF EXACT AND APPROXIMATE FORMS OF THE RANDOMIZATION TEST FOR TWO INDEPENDENT SAMPLES M.S. Thesis
Derek H. Hesse Sep. 1987 58 p
(AD-A186815) Avail: NTIS HC A04/MF A01 CSCL 12A

The practical applicability of randomization tests is discussed. The randomization test for two independent samples is the specific test examined in both hypothesis and significance testing contexts. This test has optimum theoretical properties as a nonparametric procedure for comparing the means of two populations. However, the calculations that are required to actually use the test in practice can be extremely time consuming. Using the randomization test for two independent samples to conduct a significance test is

shown to be a P-complete enumeration problem. This implies that a computationally efficient way to perform an exact version of the procedure is not likely to exist. Two approximate ways to perform the randomization test are studied with the aid of a simulation. One method uses a normal distribution to approximate the actual randomization distribution and the other method is the usual two sample t-test. The t-test is found to yield results very close to those obtained from the exact randomization test under the conditions studied. GRA

N88-17382# Naval Postgraduate School, Monterey, Calif.
AN APL FUNCTION FOR BIVARIATE NORMAL PROBABILITIES Technical Report, Oct. 1986 - Jul. 1987
Toke Jayachandran Aug. 1987 16 p
(AD-A186535; NPS53-87-004) Avail: NTIS HC A03/MF A01 CSCL 12A

An APL function to compute cumulative probabilities for a standard bivariate normal distribution is presented. The function can be run on an IBM-PC/AT compatible microcomputer such as the Zenith X-248, as well as on the IBM 3033 mainframe computer. GRA

N88-17383# Naval Postgraduate School, Monterey, Calif.
THE LINEAR DEPENDENCY STRUCTURE OF COVARIANCE NONSTATIONARY TIME SERIES Technical Report
Will Gersch Jun. 1987 38 p
(AD-A186548; NPS-55-87-006) Avail: NTIS HC A03/MF A01 CSCL 12A

The linear dependence, feedback and casuality structure of covariance nonstationary time series is developed. At every instant in time, the amount of linear dependence between time series vectors is expressible as the sum of the amount of feedback from the first time series vector to the second, the amount of feedback from the second time series to the first and the amount of instantaneous feedback. The parametric modeling of multivariate covariance nonstationary time series and the computation of their interdependency structure from the fitted model are also treated. The time series is modeled by a multivariate time varying autoregressive (MVTVAR) model. The fitted MVTVAR model yields an instantaneous power spectral density (IPSD) matrix, The IPSD is used in computing the linear dependency structure of nonstationary time series. An example of the modeling and the determination of instantaneous casuality from a human implanted electrode seizure event EEG is shown. GRA

N88-17384# Naval Postgraduate School, Monterey, Calif.
PREDICTION OF POLYTOMOUS EVENTS: MODEL DESCRIPTION, ALGORITHM DEVELOPMENT AND METHODOLOGICAL ASPECTS, WITH AN APPLICATION
I. G. OMuircheartaigh and D. P. Gaver Sep. 1987 21 p
(AD-A186549; NPS-55-87-010) Avail: NTIS HC A03/MF A01 CSCL 12A

This article addresses the problem of predicting multi-category events. It describes a new approach (based on generalized linear models) which is a natural extension of the technique of logistic regression (a method widely used for the prediction of dichotomous events). As an example, the method is applied to the prediction of tropical storm imminence, and the performance of the method is compared with that of alternative well-established techniques. GRA

N88-17385# Pittsburgh Univ., Pa. Center for Multivariate Analysis.
STRONG CONSISTENCY OF CERTAIN INFORMATION THEORETIC CRITERIA FOR MODEL SELECTION IN CALIBRATION, DISCRIMINANT ANALYSIS AND CANONICAL CORRELATION ANALYSIS Technical Report
R. Nishii, Z. D. Bai, and P. R. Krishnaiah Dec. 1986 19 p
(Contract F49620-85-C-0008)
(AD-A186584; TR-86-42; AFOSR-87-1005TR) Avail: NTIS HC A03/MF A01 CSCL 12A

This paper shows that the criteria for model selection based upon efficient detection (ED) criterion are consistent for certain problems in multivariate calibration, discriminant analysis and canonical correlation analysis. These results will be proved under mild conditions on the underlying distribution. GRA

N88-17386# Ballistic Research Labs., Aberdeen Proving Ground, Md.
AN APPLICATION OF FUZZY SET THEORY TO STATISTICAL HYPOTHESIS TESTING
William E. Baker Jun. 1987 28 p
(AD-A186705; BRL-TR-2824) Avail: NTIS HC A03/MF A01 CSCL 12A

In many instances the data used in statistical hypothesis testing may be vague or imprecise and, as such, may suggest results that are incorrect. Rank tests, in particular, seem susceptible, since the original data, once ranked, have no further influence on the testing procedure no matter how closely they are grouped. A possible solution is to treat the ranks as fuzzy integers represented by membership functions that indicate the degree to which each rank assumes each integer value. In this paper, a method is suggested for obtaining these membership functions and the concept is incorporated into an existing rank test. An application of this fuzzy hypothesis testing procedure is provided. GRA

N88-17387# Virginia Univ., Charlottesville. Dept. of Electrical Engineering.
OUTLIER RESISTANT PREDICTIVE SOURCE ENCODING FOR A GAUSSIAN STATIONARY NOMINAL SOURCE Technical Report, period ending, 1 Jul. 1987
P. Kazakos 18 Sep. 1987 43 p
(Grant AF-AFOSR-0224-87)
(AD-A186725; UVA/525682/EE88/102; AFOSR-87-1530TR)
Avail: NTIS HC A03/MF A01 CSCL 12A

A sequence of qualitatively robust predictive source encoders, for a Gaussian stationary source with outlier contaminated observation data, is proposed and analyzed. Performance measures include mean difference-sequence distortion and output entropy at the nominal Gaussian source, as well as breakdown point and influence function. The proposed sequence of predictive encoders attains strictly positive breakdown point and uniformly bounded influence function, at the expense of increased mean difference-squared distortion and differential entropy, at the Gaussian nominal source. GRA

N88-17388# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Mathematical Statistics.
A PROHOROV BOUND FOR A POISSON PROCESS AND A BERNOULLI PROCESS
E. Valkeila (Helsinki Univ., Finland) Jan. 1987 13 p Sponsored by the Ella and Georg Ehrnrooth Foundation, the Finnish Ministry of Education, and the Netherlands Ministry of Education
(CWI-MS-R8701; B8711101; ETN-88-91569) Copyright Avail: NTIS HC A03/MF A01

For M a counting process with the compensator A and N the Poisson process with the compensator B, an upper bound for the Prohorov distance between the two processes in terms of the compensators, when the other processes is a Bernoulli process with dependency, is given. ESA

N88-17389# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Mathematical Statistics.
RANDOM TRUNCATION MODELS AND MARKOV PROCESSES
Niels Keiding (Copenhagen Univ., Denmark) and Richard D. Gill Feb. 1987 58 p
(CWI-MS-R8702; B8711102; ETN-88-91570) Copyright Avail: NTIS HC A04/MF A01

The life table with delayed entry is reviewed. The product-limit estimator is the continuous-time version of the life table, and its generalization to allow for delayed entry, or left truncation, is considered. It is shown how the derivation of a nonparametric estimator of a distribution function under random truncation is a special case of results on the statistical theory of counting processes by Aalen and Johansen. This framework also clarifies the status of the estimator as nonparametric maximum likelihood

estimator, and consistency, asymptotic normality and efficiency may be derived directly as special cases of Aalen and Johansen's general theorems and later work. ESA

N88-17390*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
EXAMPLES OF NONCONSERVATISM IN THE CARE 3 PROGRAM
Kelly J. Dotson Jan. 1988 27 p
(NASA-TM-100524; NAS 1.15:100524) Avail: NTIS HC A03/MF A01 CSCL 12A

This paper presents parameter regions in the CARE 3 (Computer-Aided Reliability Estimation version 3) computer program where the program overestimates the reliability of a modeled system without warning the user. Five simple models of fault-tolerant computer systems are analyzed; and, the parameter regions where reliability is overestimated are given. The source of the error in the reliability estimates for models which incorporate transient fault occurrences was not readily apparent. However, the source of much of the error for models with permanent and intermittent faults can be attributed to the choice of values for the run-time parameters of the program. Author

N88-17391# Sandia National Labs., Albuquerque, N. Mex.
CALCULATING MEASUREMENT IMPRECISION AND UNCERTAINTY
P. A. Klevgard Nov. 1987 40 p
(Contract DE-AC04-76DP-00789)
(DE88-003981; SAND-86-8233) Avail: NTIS HC A03/MF A01

This study is intended to act as a guide in the application of certain statistical techniques to typical test data. A tutorial approach is employed, with specific examples illustrating all of the calculations required for both random uncertainty and systematic uncertainty. Three different situations are covered: multiple data values that apply to but a single test point and require a single uncertainty value; multiple data values over a variety of test points with individual uncertainty values applying to the individual test points; and multiple data values over a variety of test points with a single, pooled uncertainty value applying to all the test points. DOE

66 SYSTEMS ANALYSIS

Includes mathematical modeling; network analysis; and operations research.

N88-17392# Naval Postgraduate School, Monterey, Calif.
THE EVOLUTION OF NAVAL WARFARE TECHNOLOGY AND THE IMPACT OF SPACE SYSTEMS M.S. Thesis
Patrick J. Sharrett Sep. 1987 178 p
(AD-A186900) Avail: NTIS HC A09/MF A01 CSCL 15F

This thesis traces the history of naval warfare technology from antiquity to modern times. By analyzing various technological innovations, including their development, assimilation, and employment by navies in battle, five basic naval warfare trends are identified to which technological changes have contributed. These trends are: increasing the size of area which force can control; increasing force endurance; reduction of reaction and weapon delivery times; reduction of exposure and risk to a force; increasing the probability of kill per weapon. Citing these trends, the author discusses some of the current contributions of space systems to naval warfare operations. Although most changes have been evolutionary in nature, space systems have the potential to be revolutionary because of their contribution to all five trends. Consequently, increased emphasis on and support of space system development by the U.S. Navy is recommended. GRA

N88-17393# Naval Postgraduate School, Monterey, Calif.
THE IMPACT OF DEPLOYMENT RATES ON THE EFFECTIVENESS OF STRATEGIC DEFENSES M.S. Thesis
Frederick W. Weber, Jr. Sep. 1987 65 p
(AD-A186907) Avail: NTIS HC A04/MF A01 CSCL 15C

The effectiveness of a Ballistic Missile Defense layer of Space-Based Kinetic Kill Vehicles is examined relative to a threat with increasing numbers of Fast-Burn Boosters over the years 1994-2004. A methodology for evaluating Ballistic Missile Defense layer effectiveness and required deployment rates over time is developed. GRA

N88-17394# Air War Coll., Maxwell AFB, Ala.
A STRATEGY FOR SPACE WARFARE
Alfred R. Garcia, Jr Mar. 1987 79 p
(AD-A186658; AU-AWC-87-070) Avail: NTIS HC A05/MF A01 CSCL 12B

This report develops a strategy for space systems warfare that provides National Command Authorities with options that go beyond space systems. It examines policy, doctrine, and legal aspects of space systems, and finds that more should be done in those areas. It postulates space system warfare scenarios to include attacks on ground and control systems and covert and overt attacks on spacecraft; analyzes present space warfare strategy using Fabyanic model and finds that present strategy is lacking in war fighting content. Finally, it develops a new space warfare strategy with several options using Crowls' model and applies classical strategists. A new strategy employs more elements of power than just space systems. The author makes recommendations to correct several problems. GRA

67 THEORETICAL MATHEMATICS

Includes topology and number theory.

No abstracts in this category.

70 PHYSICS (GENERAL)

For precision time and time interval (PTTI) see *35 Instrumentation and Photography;* for geophysics, astrophysics or solar physics see *46 Geophysics, 90 Astrophysics,* or *92 Solar Physics.*

N88-17395# Joint Publications Research Service, Arlington, Va.
JPRS REPORT: SCIENCE AND TECHNOLOGY. USSR: PHYSICS AND MATHEMATICS
27 Oct. 1987 67 p Transl. into ENGLISH from various Russian articles
(JPRS-UPM-87-009) Avail: NTIS HC A04/MF A01

JPRS Report UPM-87-009 of 27 October 1987: Science and Technology (USSR: Physics and Mathematics) contains articles on Acoustics, Crystals, Laser Glasses and Semiconductors, Optics and Spectroscopy, Superconductivity, and Technical and Theoretical Physics. For individual titles, see N88-17396 through N88-17431.

N88-17396# Joint Publications Research Service, Arlington, Va.
USE OF BOUNDARY-LAYER METHOD FOR PROBLEM OF SOUND PROPAGATION THROUGH CHANNEL WITH VARIABLE CROSS-SECTION CONTAINING STREAM OF FLUID Abstract Only **c71**
A. F. Gladenko and Ye. A. Leontyev *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 27 Oct. 1987 p 1 Transl. into ENGLISH from Akusticheskiy Zhurnal (Moscow, USSR), v. 33, no. 2, Mar. - Apr. 1987 p 212-218 (For primary document see N88-17395 09-70)
Avail: NTIS HC A04/MF A01

Propagation of sound through a rigid cylindrical channel with a smoothly and only slowly varying cross section containing a fluid in motion is analyzed by the boundary-layer method according to the classical theory of diffraction, this method being modified here for the situation of particular interest where in some channel cross section the frequency of sound is equal to the critical frequency.

The procedure, based on waveguide solutions to the Blokhintsev equation for the total enthalpy with appropriate boundary conditions, leads to a system of equations for two functions, rho and theta, which must satisfy a system of equations equivalent to equations of the eikonal for the moving fluid and yields asymptotic expressions for the parameters of acoustic modes in such a channel. The results are consistent with known results for a channel containing fluid at rest. Author

N88-17397# Joint Publications Research Service, Arlington, Va.
LINEAR THEORY OF GENERATION OF LONGITUDINAL SOUND WAVES IN SEMICONDUCTORS UPON INTERBAND ABSORPTION OF OPTICAL RADIATION Abstract Only **c71**
V. E. Gusev and Ye. G. Petrosyan *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 27 Oct. 1987 p 1-2 Transl. into ENGLISH from Akusticheskiy Zhurnal (Moscow, USSR), v. 33, no. 2, Mar. - Apr. 1987 p 223-232 (For primary document see N88-17395 09-70)
Avail: NTIS HC A04/MF A01

A consistent mathematical theory is developed describing optical excitation of longitudinal sound waves in semiconductors. It includes two possible crystal deformation mechanisms, namely deformation due to thermal expansion and during photogeneration or recombination of charge carriers. The theory is based on the one-dimensional nonhomogeneous wave equation for the vibrational velocity potential. The solution of this equation involves a Fourier transformation with respect to time and a Laplace transformation with respect to the space coordinate yields, assuming negligible absorption of sound waves, and including the vibrational velocity of a travelling sound wave. A simple model is used to describe the kinetics of photoexcited charge carriers and of lattice heating, with appropriate boundary conditions at the point x=0. The exact solution to the two equations of this model yields the spectrum of acoustic pulses and reduces to a simple form by virtue of a strong inequality between the three relevant characteristic lengths lambda sub T much less than lambda sub D much less than lambda sub A (lambda sub T is the length of the thermal wave, lambda sub D is the length of the diffusion wave, lambda sub A is the length of the acoustic wave). The solution is then analyzed in four different regions with the distance of light absorption L much greater than lambda sub D and namely where L much greater than lambda sub A, lambda sub D much less than L much less than lambda sub A, lambda sub T much less than L much less than lambda sub D, L much less than lambda sub T, respectively. Author

N88-17398# Joint Publications Research Service, Arlington, Va.
ATTENUATION OF ULTRASONIC WAVES IN NONMAGNETIZED MAGNETIC FLUIDS Abstract Only **c71**
I. S. Koltsova *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 27 Oct. 1987 p 3 Transl. into ENGLISH from Akusticheskiy Zhurnal (Moscow, USSR), v. 33, no. 2, Mar. - Apr. 1987 p 256-260 (For primary document see N88-17395 09-70)
Avail: NTIS HC A04/MF A01

An experimental study of ultrasonic waves propagating through nonmagnetized magnetic fluids, suspensions of nearly spherical iron particles with a radius of the order of 50 A and an approximately 20 A thick surfactant coating in kerosene, was made for a quantitative evaluation of the wave attenuation mechanism which adds to the acoustic absorption mechanism. The corresponding second loss coefficient characterizing transfer of energy during interaction of an ultrasonic wave and an inhomogeneity in the medium with attendant additive excitation of shear, viscous, and thermal waves was measured as a lump sum of the respective component coefficients over the 0.1 to 3.5 percent range of particle concentration and the 2x10 to the 5th to 3x10 to the 7th power Hz range of ultrasonic frequency. It was measured by the reverberation method at the lower frequencies of 2x10 to the 5th to 3x10 to the 6th power Hz and by the pulse method with variable distance at the higher frequencies of 3x10 to the 6th to 3x10 to the 7th Hz. Experimental results confirm theoretical predictions regarding the concentration dependence and the frequency dependence of this second attenuation coefficient, those predictions being based on individual analysis of all wave excitation mechanisms and characteristics. Accordingly, the second attenuation coefficient depends linearly on the particle concentration and quadratically on the wave frequency until relaxation begins above 10 to the 6th Hz so that its frequency dependence becomes weaker. Author

N88-17399# Joint Publications Research Service, Arlington, Va.
SPACE-TIME PROCESSING OF FIELD PRODUCED BY MOVING SOURCE Abstract Only **c71**
D. Ye. Leykin *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 27 Oct. 1987 p 4 Transl. into ENGLISH from Akusticheskiy Zhurnal (Moscow, USSR), v. 33, no. 2, Mar. - Apr. 1987 p 281-286 (For primary document see N88-17395 09-70)
Avail: NTIS HC A04/MF A01

Space-time processing of a scalar wave field for detection of a moving signal source is analyzed by representing such a field as an additive mixture of signal and interference in the space-time domain. The signal is assumed to come from a point source of stationary Gaussian noise moving in a homogeneous free space along a sought trajectory. A detection algorithm which includes weighting with respect to variations of signal parameters is constructed on the basis of sufficient statistics. Its sensitivity to signal parameters including those of motion of the source is characterized by the signal-to-interference ratio and is determined with the aid of the generalized uncertainty function, the latter having the structure of the normalized signal-to-interference ratio. This function is calculated for signals whose spectra are wider or narrower than the frequency resolution and possible Doppler shifts, also for a signal with a continuous spectrum containing a narrow spike. The results indicate the necessary focusing characteristics of a stationary space-time processing receiver antenna and can be extended to a moving one. Author

N88-17400# Joint Publications Research Service, Arlington, Va.
PROPAGATION OF CREEP WAVES AROUND ROUGH CYLINDRICAL SURFACE Abstract Only **c71**
Yu. Yu. Popov *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 27 Oct. 1987 p 6 Transl. into ENGLISH from Akusticheskiy Zhurnal (Moscow, USSR), v. 33, no. 2, Mar. - Apr. 1987 p 324-330 (For primary document see N88-17395 09-70)
Avail: NTIS HC A04/MF A01

The fields of acoustic creep waves propagating around a rough cylindrical surface are evaluated in accordance with the theory of perturbations, but by the method of nonlocal boundary conditions rather than by the method of successive approximations, assuming a statistically uniform random surface roughness. The diffraction component of the field is included along with the geometrical-optics component. The corresponding Helmholtz equation with either Dirichlet or Neumann boundary conditions at the surface is solved with the aid of a Sommerfeld-Watson transformation for a soft surface and for a rigid one. Extremely small-scale roughness and extremely large-scale roughness are treated as the two limiting cases. The results are compared with fields of creep waves around a smooth cylindrical surface and, as a special case, the field of a creep wave propagated by surface roughness alone is found. Author

N88-17401# Joint Publications Research Service, Arlington, Va.
THEORY OF TRANSIENT THERMAL SELF-FOCUSING OF SOUND BEAMS Abstract Only **c71**
M. Yu. Romanovskiy *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 27 Oct. 1987 p 7 Transl. into ENGLISH from Akusticheskiy Zhurnal (Moscow, USSR), v. 33, no. 2, Mar. - Apr. 1987 p 331-334 (For primary document see N88-17395 09-70)
Avail: NTIS HC A04/MF A01

Transient thermal self-focusing of sound waves during their passage through an attenuating medium is analyzed theoretically in terms of the lens effect in all liquids, except in the molten

metals bismuth and tellurium as well as in water, where sound propagates slower through a hotter region than through a colder one. This lens effect is described by two equations, a nonhomogeneous parabolic equation for the amplitude of sound waves and an equation of heat conduction with a heat source proportional to that squared amplitude. The geometrical acoustics approximation is applicable in the ultrasonic frequency range as long as the focal length of the nonlinear thermal lens is not larger than the diffractive divergence radius, as has been the case in experiments, considering also that the magnitude of the self-focusing effect is proportional to the fourth power of the acoustic frequency. Since the amplitude of sound waves and the attenuation coefficient are functions of the radial coordinate and the traveling-wave coordinate as well as of time, the equations of geometrical acoustics evolve into a system of five equations including one which describes an assumed parabolic radial temperature profile. Solutions of this system of equations, after appropriate change of variables, yields the self-focusing distance and the critical self-focusing energy. The theory constructed on this basis not only accurately interprets transient thermal self-focusing of sound beams observed in experiments but also explains transverse fractionation of a sound beam and the phenomenon of moving foci. Author

N88-17402# Joint Publications Research Service, Arlington, Va.
NONLINEAR AND DIFFRACTION EFFECTS IN SOUND BEAMS WITH RANDOM TRANSVERSE STRUCTURE Abstract Only **c71**
O. V. Rudenko and V. A. Khokhlova *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 27 Oct. 1987 p 7-8 Transl. into ENGLISH from Akusticheskiy Zhurnal (Moscow, USSR), v. 33, no. 2, Mar. - Apr. 1987 p 335-341 (For primary document see N88-17395 09-70)
Avail: NTIS HC A04/MF A01

Nonlinear and diffraction effects in transversely random sound beams are described jointly, considering that the nonlinear changes in the spectral composition of such sound beams influence the frequency dependence of the diffraction parameters and that presence of a transverse diffusion component in the spectrum causes different interaction than in the case of a plane noise wave. The description is based on the Khokhlova-Zabolotskaya equation for an intense sound beam. With an appropriate change of variables, this equation yields a nonlinear transverse correlation function for a constant noise field which departs from a Gaussian one at the entrance to a nonlinear medium as the sound beam propagates through that medium. While an exact expression for that correlation function has been obtained in the case of plane Riemann waves, it includes the error integral in the general case. Here the problem of diffraction in a nonlinear medium is subsequently solved for a quasi-monochromatic sound beam with a random transverse structure and with that Gaussian field distribution as boundary condition at the entrance to the medium. In this case the correlation function can be linearized and a nonlinear Fourier transform is obtained relating it to the noise spectrum in any cross section of the sound beam. Author

N88-17403# Joint Publications Research Service, Arlington, Va.
CALCULATION OF NOISE IN SPATIAL SPECKLE-FIELD HOLOGRAMS UNDER CONDITIONS OF SATURATED PHOTORESPONSE Abstract Only **c35**
V. V. Shkunov and T. V. Yakovleva *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 27 Oct. 1987 p 9 Transl. into ENGLISH from Kvantovaya Elektronika (Moscow, USSR), v. 14, no. 3, Mar. 1987 p 460-465 Original language document was announced in IAA as A87-43538 (For primary document see N88-17395 09-70)
Avail: NTIS HC A04/MF A01

Speckle theory methods are used to calculate the diffraction efficiency and intermodulation noise of speckle-field bulk holograms with allowance for photoresponse saturation. It is shown that the depth of the light-induced phase modulation of the reading wave should be no less than 10 rad in order to achieve 100 percent diffraction efficiency. The photoresponse saturation reduces the relative noise level if the ratio of the intensities of the object and the reference waves recording the hologram is less than 0.5. Author

N88-17404# Joint Publications Research Service, Arlington, Va.
MIRRORS FOR HIGH-POWER CONTINUOUS-WAVE Ar-LASERS Abstract Only **c36**
N. D. Goldina, V. I. Donin, G. N. Nikolayev, and T. T. Timofeyev *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 27 Oct. 1987 p 10 Transl. into ENGLISH from Kvantovaya Elektronika (Moscow, USSR), v. 14, no. 3, Mar. 1987 p 564-573 Original language document was announced in IAA as A87-43550 (For primary document see N88-17395 09-70)
Avail: NTIS HC A04/MF A01

The characteristics of mirrors for a high-power visible-range argon laser are studied. The mirrors were manufactured via thermal resistive sputtering, electron-beam evaporation, and cathode sputtering. For the best samples, the scattering coefficients are equal to 0.04 to 0.1 percent and the absorption coefficients amount to 0.02 to 0.03 percent. While the beam strength is not directly related to the scattering and absorption of coatings, it does depend on their method of preparation. It is found that cathode-sputtered mirrors possess the best operating characteristics in high-power CW argon lasers. The problem of thermal laser focusing due to surface absorption in the output mirror is discussed. Author

N88-17405# Joint Publications Research Service, Arlington, Va.
SEMICONDUCTOR LASER WITH ELECTRON-BEAM PUMPING AND FIBER-OPTIC OUTPUT WAVEGUIDE Abstract Only **c36**
I. G. Goncharov and A. A. Kirillovich *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 27 Oct. 1987 p 18-19 Transl. into ENGLISH from Kvantovaya Elektronika (Moscow, USSR), v. 14, no. 1, Jan. 1987 p 94-99 Original language document was announced in IAA as A87-38314 (For primary document see N88-17395 09-70)
Avail: NTIS HC A04/MF A01

The active region of a semiconductor laser with transverse electron-beam pumping was coupled directly to a multimode optical waveguide with a core diameter of 50 microns. For homogeneous, waveguide, and three-layer epitaxial structures of a GaAs-GaAlAs laser, the power delivered to the waveguide was 34, 430, and 35 mW, respectively, while the input efficiency amounted to 0.1, 0.3, and 0.06, respectively. Due to the narrowing of the directivity pattern and an increase in the lasing power in the scheme with an external mirror, the spectral and total brightness of the laser increased. Author

N88-17406# Joint Publications Research Service, Arlington, Va.
PARAMETRIC INTERACTION OF OPTICAL MODES IN FIBER-OPTIC LIGHT GUIDE Abstract Only **c74**
V. L. Stirzhevskiy, V. A. Fonmaniy, and Yu. N. Yashkir *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 27 Oct. 1987 p 21 Transl. into ENGLISH from Optika i Spektroskopiya (Leningrad, USSR), v. 62, no. 3, Mar. 1987 p 674-677 (For primary document see N88-17395 09-70)
Avail: NTIS HC A04/MF A01

Parametric interaction of optical modes in an arbitrary fiber-optic structure with quadratically nonlinear susceptibility is analyzed, assuming propagation of natural modes along the fiber axis and a known transverse field distribution. Generation of a sum-frequency wave by interaction of a pump wave and an infrared signal wave is considered, for specificity, assuming that the amplitudes of all three fields vary slowly as functions of the longitudinal coordinate. The corresponding system of integro-differential equations is solved for TEM modes, in standard shorthand notation, with the mathematical apparatus of Bessel and Hankel functions. The solution yields the overlap integral and the Umov-Poynting vector. On this basis we calculate the dependence of the conversion efficiency on the fiber radius and on the half-width of the Gaussian pump-power distribution over modes in a fiber of given radius, this half-width being normalized to the number of the highest-order mode still propagating at the pump wavelength and being

proportional to the angular width of the laser beam at the fiber entrance. Author

N88-17407# Joint Publications Research Service, Arlington, Va.
COLOR SHADOW METHODS OF ANALYZING RECONTRUCTED WAVE FRONT Abstract Only c35
I. S. Zeylikovich, A. M. Lyalikov, and N. M. Spornik *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 27 Oct. 1987 p 22 Transl. into ENGLISH from Optika i Spektroskopiya (Leningrad, USSR), v. 62, no. 3, Mar. 1987 p 659-663 (For primary document see N88-17395 09-70)
Avail: NTIS HC A04/MF A01

Two-color shadow holography is proposed, gradients of the refractive index of the phase object being visualized in two mutually perpendicular directions with the use of a Foucault knife-edge diagram. Gas lasers are most suitable as the two light sources with sufficiently narrow spectra, typically a He-Ne laser (lambda sub 1 = 632.8 nm) and a He-Cd laser (lambda sub 2 = 441.6 nm). The two beams, each scattered by a rotating screen and then passed through a converging lens, a slit, and a collimating lens, enter a splitting cube at right angles and leave it to illuminate the hologram. The latter is followed by a lens which focuses transmitted light onto two mutually perpendicular Foucault knife edges preceded by a filter. Two filters are used: one in diffraction order -1 transmits light lambda sub 1 and absorbs light lambda sub 2, one in diffraction order +1 transmits light lambda sub 2 and absorbs light lambda sub 1. Color shadow patterns are quantitatively processed not with a source of white light producing one such pattern but with tunable quasi-monochromatic light producing monochromatic shadow patterns at various wavelengths of the reconstructing light. This method is demonstrated experimentally. Author

N88-17408# Joint Publications Research Service, Arlington, Va.
OPTICAL FOURIER TRANSFORMATION BY LENSLESS METHOD WITH PERFORATED MASK AND WITH MODIFIED TALBOT INTERFEROMETER FOR ANALYSIS OF INTERFEROGRAMS Abstract Only c74
A. P. Smirnov *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 27 Oct. 1987 p 23 Transl. into ENGLISH from Optika i Spektroskopiya (Leningrad, USSR), v. 62, no. 3, Mar. 1987 p 636-643 (For primary document see N88-17395 09-70)
Avail: NTIS HC A04/MF A01

A method of performing optical Fourier transformation is proposed which involves two Talbot effects, i.e., by multiplication of the spectra of the Fourier object in the Fresnel diffraction region of a periodically dotted 2-D screen, and by phase modulation of the field in the Fresnel image consisting of diffraction patterns localized between self-reproduction planes. The two advantages of this method over shift methods of interferometry are that it applies to a wider class of objects, since the interference pattern must remain sufficiently sharp, and it provides a means of measuring the signal amplitude. The phenomenon of lensless multiplicative Fourier transformation can be demonstrated experimentally not only when the object-transparency with unknown transmission amplitude-phase function lies in the plane of the perforated screen, but also when it lies anywhere between the screen plane and the observation plane, the latter being selected with many degrees of freedom. The phenomenon of phase modulation has also been demonstrated experimentally. For analysis by an appropriately modified Talbot interferometer, the source is illuminated with a plane wave of unity amplitude. Analysis of the interferometer according to the theory of linear systems and the Talbot theory reveals a finite spectrum of the object field and a Fourier spectrum with a scale factor which varies as the location of the object between the two planes is varied. Author

N88-17409# Joint Publications Research Service, Arlington, Va.
KINETICS AND SPECTRUM OF LIGHT PULSE USED IN PICOSECOND HOLOGRAPHY Abstract Only c35
R. F. Malikov and R. Kh. Mustafin *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 27 Oct. 1987 p 24 Transl. into ENGLISH from Optika i Spektroskopiya (Leningrad, USSR), v. 62, no. 3, Mar. 1987 p 631-635 (For primary document see N88-17395 09-70)
Avail: NTIS HC A04/MF A01

Picosecond holography in spectrally selective media with special nonuniform contour is analyzed for the dependence of the form and the spectrum of the output signal on the form and the tranverse relaxation of the incident probing pulse. Application of the theory of coherent light pulse amplification based on the Maxwell-Block equation, assuming linear amplification in a medium with large nonuniform broadening and then assuming negligible changes in population inversion, reveals that the spectrum of the output signal duplicates the hologram on a nonuniform contour while transverse relaxation suppresses modulation in the Fourier spectrum and thus causes fading of the hologram. The equation is first solved analytically, after linearization, and then numerically for a YAG:Nd (3+) crystal as spectrally selective medium with either a small area (theta less than 1) or a large area (theta similar to 1) of the incident field and thus with correspondingly linear or nonlinear amplification. The results indicate that linear amplification and an incident field with a spectrum at least as wide as the large nonuniform contour will ensure retention and erasure of holograms in such an absorbing medium. Author

N88-17410# Joint Publications Research Service, Arlington, Va.
SCATTERING OF OPTICAL RADIATION BY BURSTING WATER PARTICLES IN FOG Abstract Only c74
V. I. Kokhanov, M. F. Nebolsin, and L. K. Chistyakova *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 27 Oct. 1987 p 26 Transl. into ENGLISH from Izvestiya Vysshikh Uchebnykh Zavedeniy: Fizika (Tomsk, USSR), v. 30, no. 2, Feb. 1987 p 79-84 (For primary document see N88-17395 09-70)
Avail: NTIS HC A04/MF A01

An experimental study of optically thin fog interacting with radiation pulses from a CO2 laser was made with the aid of probing radiation from a He-Ne laser. Pulses of acting radiation, of microsecond duration and up to 10 J energy with the energy density varied over the 1 to 50 J/sq cm range by means of 60 micron thick 50 percent transmission dacron filters, were recorded by an FP-5 photoreceiver indicating their time distribution. Fog with an optical thickness tau sub 0.63 of the order of 10 to the -3 was generated by a machine ejecting it in the form of a jet 2.5 mm in diameter with a velocity of 8 m/s and with a 3.3 x 10 to the 4th/cu cm concentration of water drops having a mean cubic radius of 2.4 microns, perpendicularly to the acting laser beam and completely within the focusing region. The probing laser beam crossed the fog at a 45 deg angle to the acting one. Its scattering by water drops in the fog was recorded by an FEU-38 photomultiplier using optics with a 1-deg field of vision. The results of this probe reveal the dynamics of channel formation in a fog by passing laser radiation which causes bursting of water drops. The data yield the turbidization and transillumination as well as the dimensions of the explosion products and their degree of vaporization during the tail of an acting radiation pulse, all depending on its energy density. They also reveal appreciable scattering of visible radiation from a probing He-Ne laser by shock waves but only during the initial period of gas-dynamic bursting not longer than the characteristic time equal to the diameter of the laser beam divided by the speed of sound. Author

N88-17411# Joint Publications Research Service, Arlington, Va.
STATISTICS OF BREAKDOWN CENTERS APPEARING DURING PROPAGATION OF LASER RADIATION THROUGH TURBULENT ATMOSPHERE Abstract Only c36
M. S. Belenkiy, Yu. D. Kopytin, and S. T. Penin *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 27 Oct. 1987 p 29 Transl. into ENGLISH from Izvestiya Vysshikh Uchebnykh Zavedeniy: Fizika (Tomsk, USSR), v. 30, no. 2, Feb. 1987 p 75-79 (For primary document see N88-17395 09-70)
Avail: NTIS HC A04/MF A01

Focusing of laser radiation propagating through a real atmosphere with background aerosol is considered, taking into

account polydispersity of the aerosol and turbulence of the air. While polydispersity of the aerosol determines the concentration statistics of particles larger than the threshold size within the caustic region, turbulence of the air determines the lateral radiation spiking as well as the turbulent beam broadening and thus contributes to a random distribution of the threshold breakdown intensity. Randomization of breakdown centers by both factors is analyzed and their statistical characteristics are evaluated for radiation emitted by a CO2 laser in microsecond pulses and propagating through a mildly turbid atmosphere, assuming a chemically homogeneous aerosol with an asymptotic power-law distribution function f(alpha)= c sub 0 alpha sup -n-1 of particles larger than 0.1 microns and assuming a negligible thermal laser self-action during thermodynamically slow focusing by a Cassegrain telescope with R sub 0/F sub 0 greater than or equivalent to 10 to the -3. Numerical results are obtained for typical apertures and coherence radii. Author

N88-17412# Joint Publications Research Service, Arlington, Va.
MODE LOCKING IN Nd-LASER BY MEANS OF Gd-Sc-Ga-GARNET SHUTTER Abstract Only **c36**
M. I. Demchuk, Ye. V. Zharikov, A. M. Zabaznov, I. A. Manichev, V. P. Mikhaylov, A. M. Prokhorov, A. P. Shkadarevich, A. F. Chernyakovskiy, I. A. Shcherbakov, and K. V. Yumashev *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 27 Oct. 1987 p 30 Transl. into ENGLISH from Kvantovaya Elektronika (Moscow, USSR), v. 14, no. 2, Feb. 1987 p 423-424 Original language document was announced in IAA as A87-43532 (For primary document see N88-17395 09-70)
Avail: NTIS HC A04/MF A01

The mode-locking regime of a neodymium laser using shutters made of GSGG (gadolinium scandium gallium garnet) crystals is studied. With a GSGG transmission coefficient of 20 percent and a crystal length of 1 cm, ultrashort pulses with a minimum duration of 80 ns and an energy of 0.5 mJ are generated. It is shown that GSGG crystals can be used successfully as passive shutters for mode-locking in the NIR range (lambda = 1.06 microns). The advantages of these shutters over those utilizing polymethine dyes are discussed. Author

N88-17413# Joint Publications Research Service, Arlington, Va.
LASER SIMULATION OF LIGHT AND PLASMA ACTION ON COMETS AND PLANETS Abstract Only **c36**
G. A. Askaryan and I. M. Rayevskiy *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 27 Oct. 1987 p 30-31 Transl. into ENGLISH from Kvantovaya Elektronika (Moscow, USSR), v. 14, no. 2, Feb. 1987 p 229-230 Original language document was announced in IAA as A87-43501 (For primary document see N88-17395 09-70)
Avail: NTIS HC A04/MF A01

The feasibility of laser simulation of the astrophysical effects of UV-radiation bursts and plasma flows on comets and planets is studied experimentally. Integral and high-speed photography was used to record the characteristic stream-line flow conditions and the formation of the opposing ablation plasma. The different conditions for which laser simulation is applicable are discussed. Author

N88-17414# Joint Publications Research Service, Arlington, Va.
HIGH-POWER PERIODIC-PULSE YAG:Nd3+-LASER SYSTEM WITH TELESCOPIC UNSTABLE RESONATOR AND TWO-STAGE AMPLIFIER Abstract Only **c36**
P. A. Apanasevich, V. V. Kvach, V. G. Koptev, V. A. Orlovich, A. A. Stavrov, and A. P. Shkadarevich *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 27 Oct. 1987 p 31 Transl. into ENGLISH from Kvantovaya Elektronika (Moscow, USSR), v. 14, no. 2, Feb. 1987 p 265-270 Original language document was announced in IAA as A87-43506 (For primary document see N88-17395 09-70)
Avail: NTIS HC A04/MF A01

A high-power YAG:Nd (3+) laser system is described which incorporates a master oscillator with an unstable telescopic resonator, polarizational radiation dumping, and a two-stage amplifier. Energetic, temporal, spectral, and spatial characteristics of the master oscillator are studied as well as those of the system as a whole. The system makes it possible to generate radiation pulses with a power greater than 70 MW upon divergence close to the diffraction limit and a pulse repetition frequency of 10 Hz. Author

N88-17415# Joint Publications Research Service, Arlington, Va.
TUNABLE Al2O3:Ti3+-LASER WITH OPTICAL PUMPING Abstract Only **c36**
Kh. S. Bagdasarov, V. P. Danilov, T. M. Murina, Ye. G. Novikov, A. M. Prokhorov, V. B. Semenov, and Ye. A. Fedorov *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 27 Oct. 1987 p 32 Transl. into ENGLISH from Pisma v Zhurnal Tekhnicheskoy Fiziki (Leningrad, USSR), v. 13, no. 6, 26 Mar. 1987 p 369-371 (For primary document see N88-17395 09-70)
Avail: NTIS HC A04/MF A01

A tunable laser with optical pumping was realized experimentally, using an Al2O3:Ti(3+) crystal and an INPZ-7/80 flash lamp with Kvant-12 interference coating. The lamp operated with a luminaire and a K75-28 capacitor bank, the latter placed very close to the lamp so as to ensure minimum rise time of optical pumping pulses. With a capacitance of 33 microF flashes of 30 microsec duration were obtained with a rise time not exceeding 12 microsec. High quality Al2O3:Ti(3+) crystals had been grown by the method of horizontal oriented crystallization. The resonator cavity was formed by a spherical opaque substrate with dielectric coating and a plane exit mirror, three different mirrors being used with 97 percent, 91 percent, 83 percent reflection, respectively. With the 83 percent-reflection mirror and pumping pulses of 140 J energy, the laser crystals emitted pulses of 46 mJ energy. The emission threshold, 30 to 35 J pumping pulse energy, did not significantly depend on the reflection coefficient of the exit mirror. In such a nonselective cavity the emission band was only 770 to 810 nm wide, but in a dispersive cavity formed by nearly 100 percent-reflection mirrors and including a 60-deg prism the wavelength of laser emission could be varied continuously over the 690 to 870 range. The results of this study indicate the feasibility of building a widely tunable Al2O3:Ti(3+)-laser with components used for conventional YAG:Nd(3+)-lasers. Author

N88-17416# Joint Publications Research Service, Arlington, Va.
VISIBLE InGaAsP/GaAsP LASERS PRODUCED BY EPITAXIAL GROWTH FROM LIQUID PHASE Abstract Only **c36**
Zh. I. Alferov, I. N. Arsentyev, D. Z. Garbuzov, N. A. Strugov, A. V. Tikunov, and Ye. I. Chudinova *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 27 Oct. 1987 p 32-33 Transl. into ENGLISH from Pisma v Zhurnal Tekhnicheskoy Fiziki (Leningrad, USSR), v. 13, no. 6, 26 Mar. 1987 p 372-374 (For primary document see N88-17395 09-70)
Avail: NTIS HC A04/MF A01

Continuous-wave injection lasers emitting radiation at a wavelength as short as 0.653 to 0.671 microns within the visible range at a temperature of 300 K have been realized with InGaAsP/GaAsP dual heterojunctions produced by epitaxial growth from the liquid phase. The structure of these devices consisted of a GaAs/GaAsP substrate with about 40 percent P in the upper part of the GaAsP layer, In sub 0.3 Ga sub 0.7 P emitter layers, In sub 0.2 Ga sub 0.8 As sub 0.21 P sub 0.79 waveguide layers, and a narrow-band active region. As active regions InGaAsP solid solutions were used with various In:Ga:As:P ratios and with the same lattice period as that of the substrate. The threshold current density for five of such lasers varied from 0.76 to 4.0 kA/sqcm as the energy gap of the active region was widened. In a 500 micron long resonator cavity a 12 micon wide strip of such a laser emitted a power up to and even above 3MW at an excitation current of 250 to 300 mA. Author

N88-17417# Joint Publications Research Service, Arlington, Va.
DYE LASERS PUMPED BY RADIATION FROM HIGH-POWER SEMICONDUCTOR LASERS Abstract Only **c36**
O. V. Bogdankevich, M. M. Zverev, Ye. M. Krasavina, I. V. Kryukova,

and V. F. Pevtsov *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 27 Oct. 1987 p 33 Transl. into ENGLISH from Kvantovaya Elektronika (Moscow, USSR), v. 14, no. 1, Jan. 1987 p 218-219 Original language document was announced in IAA as A87-38336 (For primary document see N88-17395 09-70)
Avail: NTIS HC A04/MF A01

Dye-laser pumping by radiation from high-power CdS and ZnO lasers is observed. The semiconductor lasers were pumped by an electron beam with an energy of 350 keV and a current density of 150 A/sq, the pulse duration being 25 ns. Multicomponent semiconductor laser tragets up to 50 mm in diameter were used. A special optical system was developed which focuses the radiation into the cell with the dye. The efficiency of converting the pumping light into dye laser radiation amounted to 50 percent for the rhodamine 6G-CdS rhodamine pair (at a pulse output energy of 50 mJ) and 10 percent for the coumarin 47-ZnO pair. Author

N88-17418# Joint Publications Research Service, Arlington, Va.
CONTINUOUSLY FREQUENCY-TUNABLE HIGH-PRESSURE CO2-LASER WITH PLASMATIC CATHODE Abstract Only c36
N. V. Karlov, A. V. Kisletsov, I. O. Kovalev, G. P. Kuzmin, A. A. Nesterenko, and E. M. Khokhlov *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 27 Oct. 1987 p 34 Transl. into ENGLISH from Kvantovaya Elektronika (Moscow, USSR), v. 14, no. 1, Jan. 1987 p 216-218 Original language document was announced in IAA as A87-38335 (For primary document see N88-17395 09-70)
Avail: NTIS HC A04/MF A01

A compact high-pressure (8 atm) electric-discharge CO2 laser with a plasma cathode is developed which is based on the CO2:N2 = 1:1 working mixture. Continuous tuning of the radiation frequency in the 938 to 951, 970 to 980, 1041 to 1054, and 1073 to 1083/cm ranges is achieved at a peak power of greater than 1 MW. With a nondispersive cavity, the efficiency reaches 5 percent at a peak power of greater than 10 MW. The radiation pulse duration is 50 ns. Author

N88-17419# Joint Publications Research Service, Arlington, Va.
EFFICIENCY OF IONIC NOBLE GAS AND ALKALI METAL MOLECULES AS ULTRAVIOLET AND FAR-ULTRAVIOLET LASERS Abstract Only c36
N. G. Basov, M. G. Voytik, V. S. Zuyev, A. D. Klementov, V. P. Kutakhov, and S. A. Pendyur *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 27 Oct. 1987 p 34-35 Transl. into ENGLISH from Kvantovaya Elektronika (Moscow, USSR), v. 14, no. 1, Jan. 1987 p 185-187 Original language document was announced in IAA as A87-38325 (For primary document see N88-17395 09-70)
Avail: NTIS HC A04/MF A01

It is shown that high-power laser radiation with an efficiency of several percent and a gain of 0.001 to 0.01/cm can be generated in an Xe-Cs mixture. The dependence of the specific power of the spontaneous emission on time is plotted for Xe:Cs = 10000:3 and 1000:1 where p(Xe) = 1, 3, and 10 atm. Author

N88-17420# Joint Publications Research Service, Arlington, Va.
FEASIBILITY OF CHEMICAL LASERS BASED ON CHAIN REACTION INVOLVING HYDROGEN FLUORINATION WITH THERMAL BRANCHING MECHANISM Abstract Only c36
E. U. Baykov, A. S. Bashkin, and A. N. Orayevskiy *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 27 Oct. 1987 p 35 Transl. into ENGLISH from Kvantovaya Elektronika (Moscow, USSR), v. 14, no. 1, Jan. 1987 p 151-157 (For primary document see N88-17395 09-70)
Avail: NTIS HC A04/MF A01

A new possibility of realizing pulsed H2-F2 lasers by thermal dissociation of molecules of appropriate fluorine compounds RF is proposed, i.e., the heretofore not considered mechanism of thermal branching in the chain reaction by injection of additional such molecules into the original H2-F2 mixture. The success of this method hinges on selection of the additional fluorine compound RF whose molecules dissociate at a sufficiently high rate as the temperature of the mixture rises. Analytical solution of the corresponding equations of thermodynamics for the given chemical reactions and numerical evaluation of the dissociation rate constant for required laser performance and emission pulse characteristics, supported by experimental data, indicate that the necessary conditions are attainable with H2:F2:O2:RF mixtures with an RF molecule such as F2SO3 whose rate constant of F2SO3 yields F + FSO3 dissociation is k sub oo = 10 sup 15.13 e sup -33 (kcal/mol)/RT s sup -1. Author

N88-17421# Joint Publications Research Service, Arlington, Va.
HIGH-EFFICIENCY GaAs SEMICONDUCTOR LASER WITH LONGITUDINAL EXCITATION BY SCANNING ELECTRON BEAM Abstract Only c36
A. A. Gubarev, V. I. Kozlovskiy, B. M. Lavrushin, A. S. Nasibov, and P. V. Reznikov *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 27 Oct. 1987 p 36 Transl. into ENGLISH from Kvantovaya Elektronika (Moscow, USSR), v. 14, no. 1, Jan. 1987 p 170-176 Original language document was announced in IAA as A87-38324 (For primary document see N88-17395 09-70)
Avail: NTIS HC A04/MF A01

The paper presents the characteristics of the efficiency of gallium arsenide lasing elements with different crystal thicknesses at electron energies of 50 and 75 keV and temperatures of 80 and 300 K. The internal differential laser efficiency reaches 24 + or - 5 percent at 80 K and 7.1 + or - 1.5 percent at 300 K. It is shown that, at a laser emission intensity of 100,000 W/sqcm, illumination of the passive part of the resonator is enhanced, making the laser highly efficient. Author

N88-17422# Joint Publications Research Service, Arlington, Va.
PERIODIC-PULSE SEMICONDUCTOR LASER WITH ELECTRON-BEAM PUMPING Abstract Only c36
O. V. Bogdankevich, M. M. Zverev, S. P. Kopyt, Ye. M. Krasavina, I. V. Kryukova, L. G. Novozhilova, and V. F. Pevtsov *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 27 Oct. 1987 p 37-38 Transl. into ENGLISH from Kvantovaya Elektronika (Moscow, USSR), v. 14, no. 3, Mar. 1987 p 605-607 (For primary document see N88-17395 09-70)
Avail: NTIS HC A04/MF A01

Four semiconductor lasers emitting pulses of 8 ns duration at a repetition rate of 50 Hz were built and tested, with electron-beam pumping but without forced cooling of the active elements on sapphire heat sinks at room temperature. These lasers are a 140-micron thick ZnO crystal (lambda = 394.6 nm wavelength, P = 25 mW avr. power) with a 66 percent-reflection exit mirror and a 130 A/sqcm threshold current density, a 220-micron thick ZnSe crystal (lambda = 477.5 nm wavelength, P = 22 mW avr. power) with a 40 percent-reflection exit mirror and a 70 A/sqcm threshold current density, a 350-micron thick CdS crystal (lambda = 526.4 nm wavelength, P = 125 mW avr. power) with a 70 percent-reflection exit mirror and a 135 A/sqcm threshold current density, and a 150-micron thick GaAs crystal (P = 90 mw avr. power) with a 51 percent-reflection exit mirror and a 60 A/sq cm threshold current density. The lasers are pumped by a 200 keV beam 1 cm in diameter, in pulses of 10 ns duration and 0.5 J energy, coming from a small electron gun with field emission cathode and 150-micron thick Be foil diaphragm operating with a MIRA-4D generator of X-ray pulses. Author

N88-17423# Joint Publications Research Service, Arlington, Va.
PHENOMENOLOGICAL MODEL OF SUPERCONDUCTIVITY OF HEAVY FERMIONS IN U(SUB 1-x)ThSUBxBeSUB13 Abstract Only c76
V. V. Moshchalkov *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 27 Oct. 1987 p 42 Transl. into ENGLISH from Pisma v Zhurnal Eksperimentalnoy i Teoreticheskoy Fiziki (Moscow, USSR), v. 45, no. 4, 25 Feb. 1987 p 181-184 (For primary document see N88-17395 09-70)
Avail: NTIS HC A04/MF A01

Superconductivity of the nonmagnetic compounds UBe sub 13 with heavy fermions and impure U sub 1-x Th sub x Be sub 13

ones is examined, their superconductivity being attributable to the heavy fermions characterized by a large ratio of transition temperature T sub c to Fermi energy E sub F. Interaction of superconductivity and coherence in the Kondo lattice is described by a model Hamiltonian which includes giantly anomalous peaking of the specific heat as well as superconductivity fluctuations near that temperature. Analysis of the phenomenon takes into account the magnetic moment induced at temperatures T less than T sub c2 and stretching of the interval between transitions. Author

N88-17424# Joint Publications Research Service, Arlington, Va.
PROPERTIES OF SUPERCONDUCTING TUNNEL STRUCTURES IN MICROWAVE RADIATION FIELD Abstract Only **c76**
F. I. Korzhinskiy, S. A. Koziychuk, A. N. Korolev, V. A. Obolonskiy, A. B. Orlenko, and A. S. Polishchuk *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 27 Oct. 1987 p 43 Transl. into ENGLISH from Zhurnal Tekhnicheskoy Fiziki (Leningrad, USSR), v. 57, no. 2, Feb. 1987 p 330-335 (For primary document see N88-17395 09-70)
Avail: NTIS HC A04/MF A01

A study of Nb-NbO2-Pb superconducting tunnel structure was made for the purpose of determining their microwave characteristics. Specimens in the form of a film microcircuit consisting of a 4 to 25 sq micron large tunnel junction, a low-pass filter, and contact pads on a 0.2 mm thick 1x10 sq mm large quartz substrate were produced by electron-beam lithography, purification of the superconductor film with a beam of inert-gas ions, and thermal oxidation in active oxygen. Their current-voltage characteristics were measured in liquid helium at 4.2 K, using direct current of up to 30 microA allowing a current density of 10 to the 2nd to 10 to the 4th A/sqcm as well as with up to 40 nW microwave power at 75 GHz or 100 GHz frequency added. The experimental data, with correction for the leakage current on the basis of the noise equivalent power, reveal two soft steps along the current-voltage characteristics near the gap voltage separated by an h/f/e interval equal to 0.3 mV at 75 GHz and 0.41 mV at 100 GHZ. Close reproducibility of the results and close agreement with design calculations indicate the feasibility of microcircuit miniaturization to submicron size by using electron-beam lithography. Author

N88-17425# Joint Publications Research Service, Arlington, Va.
MECHANISM OF CHANGE OF VORTEX STRUCTURE ORIENTATION IN TYPE-2 SUPERCONDUCTORS Abstract Only **c76**
V. M. Dzugutov *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 27 Oct. 1987 p 44-45 Transl. into ENGLISH from Fizika Tverdogo Tela (Leningrad, USSR), v. 29, no. 3, Mar. 1987 p 841-845 (For primary document see N88-17395 09-70)
Avail: NTIS HC A04/MF A01

Change of the vortex structure configuration in a type-2 superconductor following a change of orientation of the external magnetic field is analyzed, considering a magnetic field which consists of two mutually orthogonal components parallel to the plane superconductor surface: a constant one and a harmonically alternating one. According to the empirical Boyer-LeBlanc model, change of orientation is accompanied by appearance of an orientation-angle gradient normal to the superconductor surface. One suggested mechanism is penetration of vortex filaments into the superconductor across a barrier related to surface imperfection, filaments parallel to the magnetic field thus changing their orientation with the latter. Experimental data under conditions where the penetration mechanism cannot be expected to work indicates an alternative mechanism associated with twisting of the vortex structure. Two superconductor specimens were tested. Analysis of the results, magnetization curves and changes in hysteresis loss, and their interpretation in terms of propagation of torsional strain with the orientation-angle gradient reaching a critical magnitude indicate that, while partial penetration of vortex filaments still occurs, change here of the vortex structure orientation is indeed not associated with their penetration. Author

N88-17426# Joint Publications Research Service, Arlington, Va.
SUPERCONDUCTIVITY AND CRYSTAL STRUCTURE OF HIGH-PRESSURE PHASES IN V-Ru-H SYSTEM Abstract Only **c76**
V. Ye. Animonov, I. T. Belash, Ye. G. Ponyatovskiy, V. I. Rashchupkin, and I. M. Romanenko *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 27 Oct. 1987 p 45-46 Transl. into ENGLISH from Fizika Tverdogo Tela (Leningrad, USSR), v. 29, no. 3, Mar. 1987 p 665-671 (For primary document see N88-17395 09-70)
Avail: NTIS HC A04/MF A01

In the search for materials which, upon hydrogenation, form phase with higher superconductor transition temperature, V-Ru alloys were selected for study. Specimens were produced by mixing electrolytic powder of each metal into three batches with 10, 18, 33 atom percent. respectively, compacting the mixtures under a pressure of 20 kbar at room temperature, and then sintering them in an induction furnace in an argon atmosphere. The compacts were annealed at 1200 C in vacuum (10 to the -6 torr) for 24 h then cooled in the furnace. The specimens of three alloys, now containing 10, 18.5., 34+0.4 atom percent Ru, respectively, were hydrogenated in an H2 atmosphere at 300 C under pressures up to 70 kbar for 24 h and then quenched under pressure to about -180 C. The hydrogen content was then determined accurately within 5 percent, from the amount of H2 evolving during thermal decomposition at 500 C. The superconducting transition temperature was measured by the inductive method. The results reveal formation of a phase with the atomic hydrogen-to-metal ratio H:Me approx = 1 and an f.c.c. metal sublattice in the V sub 90 Ru sub 10-H alloy, only this phase being superconductive at temperatures T greater than or = 2K with a 0.3 K wide transition range. Author

N88-17427# Joint Publications Research Service, Arlington, Va.
MOVING IONOSPHERIC PERTURBATIONS INDUCED BY WAVE TRAINS PROPAGATING THROUGH OCEAN Abstract Only **c46**
V. I. Pavlov and A. I. Sukhorukov *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 27 Oct. 1987 p 50-51 Transl. into ENGLISH from Pisma v Zhurnal Tekhnicheskoy Fiziki (Leningrad, USSR), v. 13, no. 6, 26 Mar. 1987 p 351-354 Original language document was announced in IAA as A87-41896 (For primary document see N88-17395 09-70)
Avail: NTIS HC A04/MF A01

It is shown analytically that a tsunami wave propagating in the ocean gives rise to ionospheric perturbations that move horizontally in the direction of the tsunami. These perturbations can be detected by radiophysical means. It is noted that a more complex atmospheric model and correct estimation of the effect of the geomagnetic field are essential for evaluating this effect at heights of 200 to 300 km, which are optimal from the standpoint of detection. Author

N88-17428# Joint Publications Research Service, Arlington, Va.
CHARACTERISTICS OF LASER-PLASMA X-RADIATION SOURCE (REVIEW) Abstract Only **c36**
A. V. Vinogradov and V. N. Shlyaptsev *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 27 Oct. 1987 p 51 Transl. into ENGLISH from Kvantovaya Elektronika (Moscow, USSR), v. 14, no. 1, Jan. 1987 p 5-26 Original language document was announced in IAA as A87-38304 (For primary document see N88-17395 09-70)
Avail: NTIS HC A04/MF A01

The radiation characteristics of complex multiply charged ions are investigated. The rates of various radiation-loss mechanisms in a homogeneous plasma are determined for wide ranges of electron-temperature (10 to 100,000 eV) electron density (10 to the 24th/cu cm), and atomic number (10 to 80). The coefficient of conversion of laser radiation into X-rays is studied for quantum energies greater than 0.1 keV. It is shown that for elements with an atomic number of about 30, the radiation losses can amount to about 25 percent of the absorbed energy. Author

N88-17429# Joint Publications Research Service, Arlington, Va.
MULTICHANNEL ANISOTROPIC SINGLE-MODE FIBER OPTICS FOR TRANSDUCERS Abstract Only **c74**
A. N. Guryanov, D. D. Gusovskiy, G. G. Devyatykh, Ye. M. Dianov, V. B. Neustruyev, and A. M. Prokhorov *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 27 Oct. 1987 p 52-53 Transl. into ENGLISH from Kvantovaya Elektronika (Moscow, USSR), v. 14, no. 3, Mar. 1987 p 609-611 Original language document was announced in IAA as A87-43556 (For primary document see N88-17395 09-70)
Avail: NTIS HC A04/MF A01

Single-mode fiber lightguides with two and four identical weakly-coupled channel situated in a common quartz-glass cladding are developed. Features of these lightguides include the preservation of the mutual coherence of the channel radiation, the identical orientation of the birefringence axes in antipodal channels, and the azimuthal dependence of the relative phase shift in the channels in the case of side deformations. These properties make it possible to develop simple schemes for a number of fiber-optic sensors of deformation, pressure, and velocity.
Author

N88-17430# Joint Publications Research Service, Arlington, Va.
CRITERION OF SINGULARITY IN GENERAL THEORY OF RELATIVITY Abstract Only **c77**
M. Ye. Gertsenshteyn and Ye. Yu. Melkumova *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 27 Oct. 1987 p 56 Transl. into ENGLISH from Izvestiya Vysshikh Uchebnykh Zavedeniy: Fizika (Tomsk, USSR), v. 30, no. 2, Feb. 1987 p 94-99 (For primary document see N88-17395 09-70)
Avail: NTIS HC A04/MF A01

The problem of singularity in the general theory of relativity is analyzed, neither the classical Lifshits-Khalatnikov approach based on analytical solution in the vicinity of a singularity nor the purely geometrical approach based on properties of time-like and isotropic geodesics being adequate. The conservative view is taken instead, based on tha validity of the equations of this theory everywhere and requiring a time-like range of material particles. The theorem about geodesics is geometrically demonstrated on a T-region of Schwarzschild metrics in vacuum, characterized by a full set of geometrical hindrances without physical curvature singularities. These are: convergence of the sequence of extendable geodesics to a nonextendable one, lack of continuity with respect to initial conditions on the Cauchy surface, and existence of slits which separate expanding and contracting T-regions. It is physically demonstrated on a physically realizable source, i.e., a charged dust sphere with a world-line boundary.
Author

N88-17431# Joint Publications Research Service, Arlington, Va.
RELATIVISTIC THEORY OF GRAVITATION AND NEW CONCEPTS ABOUT SPACE-TIME Abstract Only **c77**
A. A. Logunov *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 27 Oct. 1987 p 58 Transl. into ENGLISH from Teoreticheskaya i Matematicheskaya Fizika (Moscow, USSR), v. 70, no. 1, Jan. 1987 p 3-16 (For primary document see N88-17395 09-70)
Avail: NTIS HC A04/MF A01

Following an overview of Minkowski's and Einstein's modifications of Newtonian physics, along with Lobachevskiy's and Riemann's modifications of Euclidean geometry, the General Theory of Relativity is outlined with emphasis on departures from classical concepts in physics such as energy and momentum conservation as well as from the Faraday-Maxwell concept of a gravitational field. The subsequently developed relativistic theory of gravitation is then shown to satisfy those laws of consevation and to describe the gravitational field with a symmetric tensor. Geometrization is shown to connect this tensor to the metric Minkowski-space tensor, by virtue of the universality of gravitational field and matter interaction. Physical corollaries of this theory are prediction of the latent mass in the Universe with an energy density of almost 40 times higher than that of known matter, an explanation of all experimental data gravitational phenomena in the solar system, and new concepts about gravitational radiation. Predictions based on the general theory of relativity are shown to be arbitrary and intuitive rather then logical, Einstein's gravitational equations deriving rather from the relativistic theory of gravitation. The latter predicts, moreover, both evolution and gravitational collapse of a Friedman Universe.
Author

N88-17432# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Cologne (West Germany).
SCIENTIFIC COLLOQUIUM IN HONOR OF PROF. DR. RER. NAT. HERMANN L. JORDAN
Jun. 1987 127 p Partly in GERMAN and ENGLISH Colloquium held in Cologne, Fed. Republic of Germany, Jun. 1987 Report will also be announced as translation (ESA-TT-1101) Original contains color illustrations
(DFVLR-Mitt-87-11; ISSN-0176-7739; ETN-88-91695) Avail: NTIS HC A07/MF A01; DFVLR, Cologne, Fed. Republic of Germany DM 29

The systems techniques of the flying simulator ATTAS are described. The variety of solutions of fluid-mechanical model equations is treated. The compatibility of microgravity experiments with dynamic perturbing effects is discussed. Energy transmission by coherent, quasi-monochromatic light beams is considered. The retardation of cold fronts at high mesoscale mountains is treated. For individual titles, see N88-17433 through N88-17437.

N88-17433# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Cologne (West Germany). Inst. fuer Flugmechanik.
FLIGHT TEST TECHNIQUE, ILLUSTRATED BY ADVANCED TECHNOLOGIES TESTING AIRCRAFT SYSTEM (ATTAS) [FLUGVERSUCHSTECHNIK AM BEISPIEL ATTAS] **c05**
Peter Hamel and Heinz Winter *In its* Scientific Colloquium in Honor of Prof. Dr. Rer. Nat. Hermann L. Jordan Jun. 1987 p 9-36 In GERMAN (For primary document see N88-17432 09-70)
Avail: NTIS HC A07/MF A01; DFVLR, Cologne, Fed. Republic of Germany DM 29

The systems techniques of the flying simulator ATTAS are described. The flexibility of the simulator is obtained by the installation of an electro-optical control system, in parallel with mechanical, conventional control. Software flexibility is obtained by a complex onboard computer system. The ATTAS has electrically manipulable control surfaces. Hardware, such as computers and avionics systems can easily be connected to the onboard data processing system. The technological applications of ATTAS, such as systems identification, the flying simulation technique, active flight control system, man-machine systems, sensor-avionics systems, air traffic management, and pilot qualification are presented.
ESA

N88-17434# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Cologne (West Germany). Inst. fuer Theoretische Stroemungsmechanik.
NUMERICAL FLUID MECHANICS [NUMERISCHE STROEMUNGSMECHANIK] **c34**
Herbert Oertel *In its* Scientific Colloquium in Honor of Prof. Dr. Rer. Nat. Hermann L. Jordan Jun. 1987 p 37-55 In GERMAN (For primary document see N88-17432 09-70)
Avail: NTIS HC A07/MF A01; DFVLR, Cologne, Fed. Republic of Germany DM 29

Solutions of fluid-mechanical model equations are treated. The dynamics of nonlinear systems is discussed. The flow transition process and the production of turbulence are explained. It is discussed to what extent the nonlinear interaction between a few modes can describe the transition to turbulent flow, and hence show the way towards transition and turbulence modeling. The use of numerical methods for the practical calculation of transonic passenger aircraft wings, and for the aerothermodynamic design of reentry vehicles, is presented.
ESA

N88-17435# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Cologne (West Germany). Inst. fuer Raumsimulation.

MICROGRAVITY EXPERIMENTS IN SPACE: COMPATIBILITY WITH DYNAMIC PERTURBING EFFECTS [MIKROGRAVITATIONS-EXPERIMENTE IM WELTRAUM - VERTRAEGLICHKEIT MIT DYNAMISCHEN STOEREINFLUESSEN] **c29**

Berndt Feuerbacher and Hans Hamacher *In its* Scientific Colloquium in Honor of Prof. Rer. Nat. Hermann L. Jordan Jun. 1987 p 57-71 In GERMAN (For primary document see N88-17432 09-70)

Avail: NTIS HC A07/MF A01; DFVLR, Cologne, Fed. Republic of Germany DM 29

The relation between the sensitivity of microgravity experiments to perturbations and the accelerations resulting from the dynamic behavior of the space vehicle was studied. Simplified physical models that allow the recognition of general trends and of the partial contribution of single effects were developed. A simple model experiment shows that the perturbation acceleration is constant at low frequencies and increases at higher frequencies. The lower limit scales drastically with the characteristic dimensions of the experiment. The careful movements of astronauts have only little effect on the experiments. It is shown that there is no point in shielding sensitive experiments against perturbations by damping measures. The only meaningful measure is to eliminate the perturbations at the source. ESA

N88-17436# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Cologne (West Germany). Inst. fuer Technische Physik.

ENERGY TRANSMISSION USING COHERENT, QUASIMONOCHROMATIC LIGHT BEAMS [ENERGIEUEBERTRAGUNG MIT HILFE KOHAERENTER, QUASIMONOCHROMATISCHER LICHTBUENDEL] **c74**

Hans Opower *In its* Scientific Colloquium in Honor of Prof. Dr. Rer. Nat. Hermann L. Jordan Jun. 1987 p 73-89 In GERMAN (For primary document see N88-17432 09-70)

Avail: NTIS HC A07/MF A01; DFVLR, Cologne, Fed. Republic of Germany DM 29

Optical energy transmission using monochromatic laser light is considered. The production of coherent light of high radiation density is discussed. Light is the most suitable energy carrier for large (extraterrestrial) distances, but only lasers can be considered as light source because of the high coherence requirements. A promising solution can be the spectrally selective use of a part of the solar quasi-monochromatic radiation for the direct excitation of lasers, whereby the unused part could be applied for a solar-dynamic power plant. Crystalline solid state materials provide good laser efficiencies. ESA

N88-17437# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Cologne (West Germany). Inst. fuer Physik der Atmosphaere.

THE RETARDATION OF COLD FRONTS AT HIGH MESOSCALE MOUNTAINS **c47**

Ulrich Schumann *In its* Scientific Colloquium in Honor of Prof. Dr. Rer. Nat. Hermann L. Jordan Jun. 1987 p 91-123 Original contains color illustrations (For primary document see N88-17432 09-70)

Avail: NTIS HC A07/MF A01; DFVLR, Cologne, Fed. Republic of Germany DM 29

The influence of high mountains on cold fronts, meteorological implications, observations, and numerical simulations, are discussed. A three-dimensional numerical model, based on the inviscid and adiabatic Boussinesq approximation, was used. Initial and boundary conditions are specified according to an analytical model for an idealized front with constant potential vorticity. For two-dimensional cases, it is shown that the foot of the front is strongly retarded if the kinetic energy is too small to let the cold air climb over the mountain. The bulk of the front is strongly retarded if the Froude number and the relative front/mountain height is small, and if the mountain is steep. In three dimensions, the front experiences deformation due to anticyclonic motion. A more complex orographic model illustrates different propagation of a front over a mountain ridge and along a big valley. ESA

N88-17438# Technische Hochschule, Darmstadt (West Germany). Fachbereich Physik.

MAGNETIC INVESTIGATIONS OF THE ONE-DIMENSIONAL HEISENBERG MAGNET Gd2Cl3 Ph.D. Thesis [MAGNETISCHE UNTERSUCHUNGEN DES EINDIMENSIONALEN HEISENBERG-MAGNETEN GD2CL3]

Reinhard Kremer 1985 163 p In GERMAN

(ETN-88-91083) Avail: NTIS HC A08/MF A01

The magnetic properties of the rare-earth-metal compound Gd2Cl3 were measured. The substance properties and preparation method of Gd2Cl3 are given. The temperature dependence of the magnetic specific heat and the magnetic susceptibility were determined. The magnetic specific heat was calculated for a Heisenberg chain with spin S=7/2. The magnetic susceptibility was interpreted with a model that also permits detailed predictions concerning exchange constant. The dynamic susceptibility was measured with electron spin resonance and nuclear magnetic resonance. The results determine the effect of spin diffusion on the dynamic behavior of the spin system. Comparison of experimental results and model calculations allows the quantitative estimate of the diffusion constant. The determination of the specific heat of Y2Cl3 provides the force constants and elucidates the lattice dynamics. ESA

N88-17439# Max-Planck-Inst. fuer Festkoerperforschung, Stuttgart (West Germany).

SUPPRESSION OF THE MASS ENHANCEMENT IN CeB6 IN HIGH MAGNETIC FIELDS

W. Joss, J. M. vanRuitenbeek, G. W. Crabtree, J. L. Tholence, A. P. J. vanDeursen, and Z. Fisk Aug. 1987 3 p Presented at the 18th Conference on Low Temperature Physics, Kyoto, Japan, 20 Aug. 1987 Prepared in cooperation with Centre National de la Recherche Scientifique, Grenoble, France, Technische Hogeschool, Eindhoven, Netherlands and Los Alamos National Lab., N. Mex.

(Contract W-31-109-eng-38)

(DE88-002946; CONF-870873-20) Avail: NTIS HC A02/MF A01

The effective mass of the itinerant electrons in the Kondo lattice system CeB6 is found to be strongly field dependent. Measurements of the de Haas-van Alphen effect at temperatures down to 60 mK in steady magnetic fields up to 22 T show a change of more than 100 percent in the cyclotron effective mass, decreasing with increasing field. The origin of the effect is not known but it is noted that a field of about 10 T corresponds to the energy scales in the system. DOE

71 ACOUSTICS

Includes sound generation, transmission and attenuation. For noise pollution see *45 Environmental Pollution.*

N88-17440*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

MEASURED AND CALCULATED ACOUSTIC ATTENUATION RATES OF TUNED RESONATOR ARRAYS FOR TWO SURFACE IMPEDANCE DISTRIBUTION MODELS WITH FLOW

Tony L. Parrott, A. Louis Abrahamson, and Michael G. Jones (PRC Kentron, Inc., Hampton, Va.) Jan. 1988 51 p

(NASA-TP-2766; L-16352; NAS 1.60:2766) Avail: NTIS HC A04/MF A01 CSCL 20A

An experiment was performed to validate two analytical models for predicting low frequency attenuation of duct liner configurations built from an array of seven resonators that could be individually tuned via adjustable cavity depths. These analytical models had previously been developed for high frequency aero-engine inlet duct liner design. In the low frequency application, the liner surface impedance distribution is unavoidably spatially varying by virtue of

available fabrication techniques. The characteristic length of this spatial variation may be a significant fraction of the acoustic wavelength. Comparison of measured and predicted attenuation rates and transmission losses for both modal decomposition and finite element propagation models were in good to excellent agreement for a test frequency range that included the first and second cavity resonance frequencies. This was true for either of two surface impedance distribution modeling procedures used to simplify the impedance boundary conditions. In the presence of mean flow, measurements revealed a fine scale structure of acoustic hot spots in the attenuation and phase profiles. These details were accurately predicted by the finite element model. Since no impedance changes due to mean flow were assumed, it is concluded that this fine scale structure was due to convective effects of the mean flow interacting with the surface impedance nonuniformities. Author

N88-17441*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
ANNOYANCE CAUSED BY ADVANCED TURBOPROP AIRCRAFT FLYOVER NOISE: SINGLE-ROTATING PROPELLER CONFIGURATION
David A. McCurdy Mar. 1988 43 p
(NASA-TP-2782; L-16301; NAS 1.60:2782) Avail: NTIS HC A03/MF A01 CSCL 20A

Two experiments were conducted to quantify the annoyance of people to advanced turboprop (propfan) aircraft flyover noise. The objectives were to: (1) determine the effects on annoyance of various tonal characteristics; and (2) compare annoyance to advanced turboprops with annoyance to conventional turboprops and jets. A computer was used to produce realistic, time-varying simulations of advanced turboprop aircraft takeoff noise. In the first experiment, subjects judged the annoyance of 45 advanced turboprop noises in which the tonal content was systematically varied to represent the factorial combinations of five fundamental frequencies, three frequency envelope shapes, and three tone-to-broadband noise ratios. Each noise was presented at three sound levels. In the second experiment, 18 advanced turboprop takeoffs, 5 conventional turboprop takeoffs, and 5 conventional jet takeoffs were presented at three sound pressure levels to subjects. Analysis indicated that frequency envelope shape did not significantly affect annoyance. The interaction of fundamental frequency with tone-to-broadband noise ratio did have a large and complex effect on annoyance. The advanced turboprop stimuli were slightly less annoying than the conventional stimuli. Author

N88-17442# Naval Postgraduate School, Monterey, Calif.
INVESTIGATION OF THERMOACOUSTIC HEAT TRANSPORT USING A THERMOACOUSTIC COUPLE M.S. Thesis
Michael L. Muzzerall Sep. 1987 75 p
(AD-A186889) Avail: NTIS HC A04/MF A01 CSCL 20A

The results of measurements of thermoacoustically generated temperature gradients in short, thin plates located in a resonant tube are reported. The temperature gradient results from a heat flow generated by the acoustic field. Measurements, at both axial and transverse positions in the tube, are made for pressure amplitudes ranging from approximately 145 dB to 162 dB re 20 uPa (rms), in argon and helium, for single plates and stacks of up to five plates having separations from approximately 4 to 40 thermal penetration depths. The results are compared to predictions based upon a theory by Wheatley and others (J. Wheatley, et al., Journal of the Acoustical Society of America, Vol. 74, pp. 153 to 170. 1983) For pressure amplitudes below 150 dB, the measurements agree with theory. At higher pressure amplitudes, the agreement diminishes. It is concluded that non-thermal effects are responsible for the discrepancies. GRA

N88-17443# Naval Postgraduate School, Monterey, Calif.
ACOUSTIC BACKSCATTERING FROM BOTTOM SEDIMENT AT NORMAL INCIDENCE IN THE LABORATORY M.S. Thesis
Ta-Te Yu Sep. 1987 100 p
(AD-A186905) Avail: NTIS HC A05/MF A01 CSCL 20A

Normally incident sound pulses were used to investigate sediment types in the laboratory. Materials of five different grain sizes, ranging in diameter from 0.16 to 5.30 mm, were used to find acoustic volume reverberation at three frequencies. An acoustic volume reverberation model was used to test the experimental data and to determine the scattering coefficients for the individual sediments. It was found that different sediments have different volume reverberations. From the slope of the trailing edge of the volume reverberation, the sediment type can be determined roughly. Different frequencies were used to find the relationship between volume reverberation and frequency, and the results showed that with increase in frequency the volume reverberation of the sediment will be decreased. GRA

N88-17444# Naval Research Lab., Washington, D.C.
COMPARISON OF THE ROUGH SURFACE REFLECTION COEFFICIENT WITH SPECULARLY SCATTERED ACOUSTIC DATA Final Report, Aug. 1986 - Feb. 1987
Allen R. Miller and Emanuel Vegh 6 Nov. 1987 13 p
(AD-A187086) Avail: NTIS HC A03/MF A01 CSCL 20A

A comparison is made between a theoretically derived family of rough surface reflection coefficients and specularly scattered acoustic data. GRA

N88-17445# Aeronautical Research Labs., Melbourne (Australia).
LABORATORY STUDIES RELATED TO IN-FLIGHT ACOUSTIC EMISSION MONITORING
S. R. Lamb Apr. 1987 23 p
(AD-A186714; ARL-MAT-TM-393; DODA-AR-004-531) Avail: NTIS HC A03/MF A01 CSCL 20A

Programmed load testing of a structural member from a MACCHI aircraft was undertaken in an attempt to determine the source of the acoustic emission previously recorded during in-flight monitoring of the same component and to compare results obtained from different equipment. Although crack growth during laboratory testing appeared similar to in-flight crack growth, the pattern of recorded AE was markedly different. The laboratory tests are described and an explanation of the test results sought. GRA

N88-17446# Technische Hogeschool, Delft (Netherlands).
THE ACOUSTIC-ELECTRIC FIELD ANALYSIS OF MULTI-LAYERED SURFACE ACOUSTIC WAVE DEVICES Ph.D. Thesis
Walter Johan Ghijsen 1987 234 p
(ETN-88-91592) Avail: NTIS HC A11/MF A01

A computational method for the modeling of a large class of configurations which can serve as a tool in the design of surface acoustic wave devices, including those involving several layers of arbitrary anisotropy, was derived. It is based on acousto-electric field description by the quasi-static approximation of Maxwell's equations and by the elastodynamic wave equations. The theory takes the electric and elastic properties as well as the piezoelectric properties of all involved media fully into account. ESA

N88-17447 Forschungsinstitut fuer Hochfrequenzphysik, Werthhoven (West Germany).
HIGH FREQUENCY ACOUSTIC UNDERWATER COMMUNICATION WITH LOW PROBABILITY OF BEING TRACED
F. Schmitt May 1987 37 p In GERMAN; ENGLISH summary
Sponsored by Bundesministerium der Verteidigung
(Rept-4-87; Lfd-261; ETN-88-91095) Copyright Avail: Issuing Activity

The maximum underwater communication distance, tmax, for carrier frequencies ranging between 25 and 100 kHz were calculated using data on transmission loss in sea water and underwater noise level. If the transmitter power is well adapted to the actual communication distance (ro) the intercept distance (within which the communication signal can be detected by an unauthorized receiver) does not exceed ro. An incoherent integration gain of 20 dB in favor of the intercept receiver was taken into account for this estimation. If ro is close to rmax, the

intercept range takes roughly the shape of a circle of radius ro. If ro is much less than rmax, the shape is generally narrower in the direction of transmission. With an appropriate choice of frequency, transmitter power and antenna dimension, the size and shape of the intercept range can be matched to the operational situation. ESA

N88-17448# Admiralty Research Establishment, Teddington (England).
COUPLED FE AND HIE METHOD FOR EXTERIOR ACOUSTICS OF AXISYMMETRIC SHELLS
J. H. James Jul. 1987 20 p
(ARE-TM(UHA)-87506; BR103045; ETN-88-91509) Copyright
Avail: NTIS HC A03/MF A01

A receptance method for calculating the exterior acoustics of axisymmetric shells is presented. A conical shell finite element is used to model the shell and the exterior Helmholtz integral equation the fluid; the displacements and pressure being represented by Fourier series expansions in the circumferential coordinate. The dynamic stiffness matrix of the system is obtained by combining the separate dynamic stiffness matrices of the fluid and structure, using normal coordinates alone to save computer time. The excitation is either a time-harmonic point force or a plane wave incident at an oblique angle. In order to validate the problem formulation and computer programs, numerical results of far field sound radiation from a spherical elastic shell are compared with those from a closed-form shell theory. ESA

N88-17449# Admiralty Research Establishment, Teddington (England).
TRANSIENT SOUND RADIATION FROM INFINITE THIN PLATE
J. H. James Aug. 1987 28 p
(ARE-TM(UHA)-87508; BR103390; ETN-88-91510) Copyright
Avail: NTIS HC A03/MF A01

A FORTRAN program for calculating the dynamics and acoustics of a thin plate, was extended to include excitations other than the unit impulse. Numerical results of acoustic radiation demonstrate the usefulness of the program. In the acoustic far field the transient sound radiation is better computed from a Fourier integral which can be interpreted in terms of drive point and surface radiation, and evaluated numerically by an application of the fast Fourier transform algorithm. Numerical examples using thin and thick plate theories are given. ESA

N88-17450*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
WIND TURBINE ACOUSTICS RESEARCH BIBLIOGRAPHY WITH SELECTED ANNOTATION
Harvey H. Hubbard and Kevin P. Shepherd Jan. 1988 34 p
(NASA-TM-100528; NAS 1.26:100528) Avail: NTIS HC A03/MF A01 CSCL 20A

Citations of documents are included, which represent the state-of-the-art of technology in each of the following acoustics subject areas: Prediction of Wind Turbine Noise; Acoustic Measurements for Wind Tunnels; Effect of Wind Turbine Noise on Building Structures, People and Communities; Atmospheric Propagation; and Measurement Technology Including Wind Screens. Documents are listed in chronological order in each section of the paper, with key documents and associated annotation listed first. The sources are given along with acquisition numbers, when available, to expedite the acquisition of copies of the documents. Author

N88-17451*# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Mechanical Engineering.
BEARING DETECTION IN THE PRESENCE OF TWO SOURCES OF VARYING COHERENCE USING THE COMPLEX CEPSTRUM
C. R. Fuller and K. B. Elliott Oct. 1987 35 p
(Grant NAG1-547)
(NASA-CR-181605; NAS 1.26:181605) Avail: NTIS HC A03/MF A01 CSCL 20A

The effect of the presence of two acoustic sources (one, the primary, whose location is to be detected) of varying coherence on a cepstral bearing finding procedure is experimentally studied. The coherence between the acoustic sources was altered by adding random noise of various SNR (signal-to-noise ratio) to the input signal of the primary source; the same base signal being fed to both sources. The results demonstrate that, when block liftering is used, the primary source bearing is reliably estimated for coherences as low as gamma sup 2 greater than or approx equal to 0.5. The results also imply that background noise (unreflected) of SNR greater than or approx equal to 10 dB will not markedly affect the accuracy of the bearing estimation algorithm. Author

N88-17452# Department of Energy, Morgantown, W. Va. Energy Technology Center.
SURFACE ACOUSTIC WAVE DEPOSITION SENSOR
G. E. Fasching and N. S. Smith Oct. 1987 21 p
(DE87-006527; DOE/METC-87-4074) Avail: NTIS HC A03

The US Department of Energy's, Morgantown Energy Technology Center (METC) has studied the use of surface acoustic waves (SAWs) in instrumentation systems that monitor deposition level and rate of change in high-temperature, corrosive-atmosphere coal conversion and utilization systems. Such deposition monitoring systems are needed to design and maintain efficient coal conversion systems. This report reviews the development of the deposition sensor and the associated testing system from the first intrusively designed rectangular, stainless steel sensor to the current cylindrical, glass-ceramic, nonintrusively designed sensor. Tests in a laboratory deposition facility have shown that the latter design, after proper calibration, is capable of monitoring deposition up to the design maximum of 3.10 times 10 to the 5th power mg/m squared (200 mg/in squared) at room temperature. Changes from this calibration occur at higher temperatures. Tests at temperatures under 100°F above room temperature indicate that further work is needed to permit use of this deposition monitoring technique at elevated temperatures. DOE

N88-17453# National Aerospace Lab., Tokyo (Japan).
AERODYNAMIC AND ACOUSTIC CHARACTERISTICS OF AN ADVANCED PROPELLER UNDER TAKE-OFF AND LANDING CONDITIONS
Hideo Nishiwaki and Katsumi Takeda 1987 13 p In JAPANESE; ENGLISH summary
(NAL-TR-935; ISSN-0389-4010) Avail: NTIS HC A03/MF A01

Three configurations of six-bladed, 400 mm diameter, scale-model advanced propellers such as backward-, forward-, and back-forward alternately installed swept blades were tested in anechoic environments with an incoming main flow velocity up to 68 m/s. Under no incoming-flow conditions, the blade separated flow was also discussed from an academic point of view. The data for the advance ratio of 0.43 to 1.15 were obtained in the aeroacoustic aspects. The alternatively swept blades arrangement showed the best performance in spanwise load distribution among the three configurations. The forward swept blades did not exhibit any aeroacoustic advantage. The alternately swept configuration as a tandem rotation has the potential for decreasing the sound levels at the blade passage frequencies by the dispersion of sound with no sacrifice of aerodynamic performance and no additional mechanical complexity. Author

N88-16646*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
RECENT LANGLEY HELICOPTER ACOUSTICS CONTRIBUTIONS
Homer G. Morgan, S. P. Pao, and C. A. Powell *In* NASA, Washington, NASA/Army Rotorcraft Technology. Volume 2: Materials and Structures, Propulsion and Drive Systems, Flight Dynamics and Control, and Acoustics Feb. 1988 p 1003-1044 (For primary document see N88-16632 09-01)
Avail: NTIS HC A25/MF A01 CSCL 20A

N88-16648*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
A DECADE OF AEROACOUSTIC RESEARCH AT NASA AMES RESEARCH CENTER

Frederic H. Schmitz, M. Mosher, Cahit Kitapliogiu, J. Cross, and I. Chang *In* NASA, Washington, NASA/Army Rotorcraft Technology. Volume 2: Materials and Structures, Propulsion and Drive Systems, Flight Dynamics and Control, and Acoustics Feb. 1988 p 1066-1090 (For primary document see N88-16632 09-01)
Avail: NTIS HC A25/MF A01 CSCL 20A

N88-16649*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
AEROACOUSTIC RESEARCH PROGRAMS AT THE ARMY AVIATION RESEARCH AND TECHNOLOGY ACTIVITY
Yung H. Yu, Fredric H. Schmitz, and H. Andrew Morse (Army Aviation Systems Command, Moffett Field, Calif.) *In* NASA, Washington, NASA/Army Rotorcraft Technology. Volume 2: Materials and Structures, Propulsion and Drive Systems, Flight Dynamics and Control, and Acoustics Feb. 1988 p 1091-1113 (For primary document see N88-16632 09-01)
Avail: NTIS HC A25/MF A01 CSCL 20A

N88-17396# Joint Publications Research Service, Arlington, Va.
USE OF BOUNDARY-LAYER METHOD FOR PROBLEM OF SOUND PROPAGATION THROUGH CHANNEL WITH VARIABLE CROSS-SECTION CONTAINING STREAM OF FLUID Abstract Only
A. F. Gladenko and Ye. A. Leontyev *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 27 Oct. 1987 p 1 Transl. into ENGLISH from Akusticheskiy Zhurnal (Moscow, USSR), v. 33, no. 2, Mar. - Apr. 1987 p 212-218 (For primary document see N88-17395 09-70)
Avail: NTIS HC A04/MF A01

N88-17397# Joint Publications Research Service, Arlington, Va.
LINEAR THEORY OF GENERATION OF LONGITUDINAL SOUND WAVES IN SEMICONDUCTORS UPON INTERBAND ABSORPTION OF OPTICAL RADIATION Abstract Only
V. E. Gusev and Ye. G. Petrosyan *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 27 Oct. 1987 p 1-2 Transl. into ENGLISH from Akusticheskiy Zhurnal (Moscow, USSR), v. 33, no. 2, Mar. - Apr. 1987 p 223-232 (For primary document see N88-17395 09-70)
Avail: NTIS HC A04/MF A01

N88-17398# Joint Publications Research Service, Arlington, Va.
ATTENUATION OF ULTRASONIC WAVES IN NONMAGNETIZED MAGNETIC FLUIDS Abstract Only
I. S. Koltsova *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 27 Oct. 1987 p 3 Transl. into ENGLISH from Akusticheskiy Zhurnal (Moscow, USSR), v. 33, no. 2, Mar. - Apr. 1987 p 256-260 (For primary document see N88-17395 09-70)
Avail: NTIS HC A04/MF A01

N88-17399# Joint Publications Research Service, Arlington, Va.
SPACE-TIME PROCESSING OF FIELD PRODUCED BY MOVING SOURCE Abstract Only
D. Ye. Leykin *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 27 Oct. 1987 p 4 Transl. into ENGLISH from Akusticheskiy Zhurnal (Moscow, USSR), v. 33, no. 2, Mar. - Apr. 1987 p 281-286 (For primary document see N88-17395 09-70)
Avail: NTIS HC A04/MF A01

N88-17400# Joint Publications Research Service, Arlington, Va.
PROPAGATION OF CREEP WAVES AROUND ROUGH CYLINDRICAL SURFACE Abstract Only
Yu. Yu. Popov *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 27 Oct. 1987 p 6 Transl. into ENGLISH from Akusticheskiy Zhurnal (Moscow, USSR), v. 33, no. 2, Mar. - Apr. 1987 p 324-330 (For primary document see N88-17395 09-70)
Avail: NTIS HC A04/MF A01

N88-17401# Joint Publications Research Service, Arlington, Va.
THEORY OF TRANSIENT THERMAL SELF-FOCUSING OF SOUND BEAMS Abstract Only
M. Yu. Romanovskiy *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 27 Oct. 1987 p 7 Transl. into ENGLISH from Akusticheskiy Zhurnal (Moscow, USSR), v. 33, no. 2, Mar. - Apr. 1987 p 331-334 (For primary document see N88-17395 09-70)
Avail: NTIS HC A04/MF A01

N88-17402# Joint Publications Research Service, Arlington, Va.
NONLINEAR AND DIFFRACTION EFFECTS IN SOUND BEAMS WITH RANDOM TRANSVERSE STRUCTURE Abstract Only
O. V. Rudenko and V. A. Khokhlova *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 27 Oct. 1987 p 7-8 Transl. into ENGLISH from Akusticheskiy Zhurnal (Moscow, USSR), v. 33, no. 2, Mar. - Apr. 1987 p 335-341 (For primary document see N88-17395 09-70)
Avail: NTIS HC A04/MF A01

72 ATOMIC AND MOLECULAR PHYSICS

Includes atomic structure, electron properties, and molecular spectra.

N88-17454# Naval Postgraduate School, Monterey, Calif.
ENERGY DISTRIBUTION OF CERENKOV RADIATION FOR FINITE FREQUENCY INTERVALS M.S. Thesis
Thomas M. Wilbur Jun. 1987 50 p
(AD-A186901) Avail: NTIS HC A03/MF A01 CSCL 20H

The equation defining the energy radiated per unit solid angle due to Cerenkov radiation is analyzed in detail, including the effects of all equation variables for a hypothetical electron accelerator experiment. Specifically, various finite frequency intervals are used in an effort to determine the optimum means of determining the details of a charge bunch in a high energy electron accelerator. In particular, it is shown how narrowband measurements as a function of angle may yield information on both the beam path length and the bunch charge parameters. As an aid to the analysis, an interactive Fortran program is presented that allows for any specific experimental parameters, with options for various output types as desired. GRA

N88-17455# Colorado Univ., Boulder. Nuclear Physics Lab.
THEORETICAL NUCLEAR PHYSICS Final Report, 1 Feb. 1984 - 31 Jan. 1987
E. Rost and P. D. Kunz 23 Jan. 1987 10 p
(Contract DE-AC02-81ER-40015)
(DE87-004504; DOE/ER-40015/1) Avail: NTIS HC A02

Nuclear theory at the University of Colorado emphasizes the study of nuclear structure through the use of nuclear reactions. Recent efforts have been focussed on the role of relativistic models in nucleon-nucleus scattering and reactions. Further work delves into the underlying bases of the reaction theory itself. DOE

N88-17456# California Inst. of Tech., Pasadena. Physics Lab.
PROPERTIES OF NUCLEI AND ELEMENTARY PARTICLES AT LOW AND INTERMEDIATE ENERGIES Progress Report, May 1985 - Aug. 1986
Felix Boehm 1986 74 p
(Contract DE-AS03-81ER-40002)
(DE88-001913; CALT-63-479) Avail: NTIS HC A04/MF A01

In this paper we report on a search for neutrino oscillations performed at the nuclear power reactor in Goesgen (Switzerland). The energy spectra of the electron antineutrinos emerging from the reactor core have been measured at distances of L sub 1 = 37.9 m (experiment 1), L sub 2 = 45.9 m (experiment 2) and L sub 3 = 64.7 m (experiment 3). The measured spectra are analyzed in terms of a two-neutrino oscillation model. Two analyses are presented: (1) the first is based exclusively on a comparison of the measured spectra obtained at the three distances L sub j. This analysis is essentially independent of any external assumptions

concerning the reactor antineutrino spectrum, the detection cross section and the detector efficiency; (2) the second analysis includes the reactor antineutrino spectrum as derived from independent beta-spectroscopic measurements. This procedure increases our sensitivity to the oscillation parameters. DOE

N88-17457# Nationaal Inst. voor Kernfysica en Hoge Energiefysica, Amsterdam (Netherlands).
EVENT CLASSIFICATION IN (ANTI)NEUTRINO EXPERIMENTS USING AN INTERNAL PICKET FENCE-EXTERNAL MUON IDENTIFIER (IPF-EMI) DETECTOR SYSTEM
N. vanEijndhoven 16 Mar. 1987 19 p
(NIKHEF-H/87-6; B8719015; ETN-88-91601) Avail: NTIS HC A03/MF A01

An algorithm to make a decision about the interaction type of events as seen in (anti)neutrino experiments is presented. About 90 percent of all recorded events are classified without ambiguities. The remaining 10 percent consists of events which are ambiguous or do not contain the data needed for classification. By introducing kinematical cuts, a sample may be obtained that permits the remaining 10 percent of the events to be classified by means of a statistical method. ESA

N88-17458# Groningen Rijksuniversiteit (Netherlands). Kernfysisch Versneller Inst.
[ACTIVITIES REPORT IN NUCLEAR PHYSICS] Annual Report, 1986
J. F. W. Jansen, ed. and O. Scholten, ed. 1986 180 p Sponsored by FOM, Nederlandse Organisatie voor Zuiver-Wetenschappelijk Onderzoek and by the Ministry of Science and Education
(ETN-88-91609) Avail: NTIS HC A09/MF A01

Experimental studies of giant resonances, nuclear structure, light mass systems, and heavy mass systems are summarized. Theoretical studies of nuclear structure, and dynamics are described. Electroweak interactions; atomic and surface physics; applied nuclear physics; and nuclear medicine are discussed. Instrumentation, cyclotron, ion source, target laboratory, electronics, and computing technology are mentioned. ESA

N88-17459# Technische Hochschule, Darmstadt (West Germany). Fachbereich Physik.
SEMICLASSICAL THEORY OF THE NUCLEAR RESPONSE FUNCTION. QUASIELASTIC ELECTRON SCATTERING Ph.D. Thesis [SEMIKLASSISCHE THEORIE FUER DIE NUKLEARE RESPONSEFUNKTION. QUASIELASTISCHE ELEKTRON-STREUUNG]
Ulrich Stroth 1986 152 p In GERMAN
(ETN-88-91082) Avail: NTIS HC A08/MF A01

A random phase approximation (RPA) theory was developed on a semiclassical basis, and applied to electron scattering. Using the Thomas-Fermi theory, the free RPA response function was expressed in a very simple formula that agrees very well with quantum mechanical exact calculations if the momentum transfers are enough. The theory was applied to electron scattering at medium momentum transfer where the spectra are dominated by the quasielastic peak; the comparison of the theory in the longitudinal and spin-vectorial channels with data for the separated response function shows reasonable agreement. The remaining discrepancies can probably be eliminated if 1p-1h and 2p-2h excitations are treated in a consistent theory. ESA

N88-17460# Technische Hochschule, Darmstadt (West Germany). Fachbereich Physik.
INVESTIGATION OF A NEW MAGNETIC DIPOLE MODE IN THE HEAVY, DEFORMED NUCLEI 154 Sm, 156 Gd, 158 Gd, 164 Dy, 168 Er, AND 174 Yb WITH HIGH RESOLUTION ELECTRON SCATTERING Ph.D. Thesis [UNTERSUCHUNG EINER NEUEN MAGNETISCHEN DIPLOMODE IN DEN SCHWEREN DEFORMIERTEN KERNEN 154SM, 156GD, 158GD, 164DY, 168ER UND 174YB MIT HOCHAUFLOESENDER ELEKTONEN-STREUUNG]
Detlev Bohle 1986 186 p In GERMAN
(ETN-88-91084) Avail: NTIS HC A09/MF A01

A magnetic dipole mode in heavy, deformed nuclei is demonstrated using inelastic electron scattering with high energy resolution. The nuclei were investigated in an electron linear accelerator; additional measurements with inelastically scattered protons were conducted in a synchrocyclotron. A collective, magnetic dipole excitation is discovered in all nuclei, and characterized as an orbit mode. The measurements on 156 Gd show strong fragmentation of the magnetic dipole strength. The experimental results were explained using three models: the two-rotor model, the random phase approximation, and the interacting boson approximation. In a macroscopic picture, the models reveal the discovered mode as a magnetic analogy of the electric dipole resonance. ESA

N88-17461# Technische Hochschule, Darmstadt (West Germany). Fachbereich Physik.
PARTICLE DESORPTION FROM NONCONDUCTING SURFACES BY HIGH ENERGY HEAVY IONS Ph.D. Thesis [TEILCHENDESORPTION VON NICHTLEITER-OBERFLAECHEN DURCH SCHWERIONEN HOHER ENERGIE]
Wolfgang Guthier May 1986 114 p In GERMAN
(ETN-88-91088) Avail: NTIS HC A06/MF A01

The desorption from nonconducting surfaces was investigated for projectile energies between 0.1 and 1.4 MeV/N. The production of positive secondary ions as well as the total particle production of several target substances (vapor-deposited on Al) were measured with Kg, Xe, and U-ions. The total production and the ratio between charged and uncharged particles depend on the projectile mass and energy. Secondary ion production as well as total production scale as the square of the electron energy loss, at low projectile energies. The orientation of the target surface with respect to the projectile affects the total production. The measurement results are best described by the modified lattice potential model. ESA

N88-17462 National Physical Lab., Teddington (England). Div. of Radiation Science and Acoustics.
THE ISO NARROW SPECTRUM SERIES OF FILTERED X-RADIATIONS AT NPL
L. R. Read and M. Hagreen Aug. 1987 83 p
(NPL-RS(EXT)-92; ISSN-0143-7135; ETN-88-91528) Copyright Avail: Issuing Activity

The Narrow Spectrum Series of filtered X-radiations were established to well within the specifications required by ISO 4037:1979. The exposure rates obtained for these radiations under conditions required for calibrations are too low for routine measurements using the primary standard free-air chamber. A transfer standard is being developed. ESA

N88-17463# Stockholm Univ. (Sweden). Inst. of Physics.
CORRECTIONS FOR THE PSEUDORAPIDITY GAP CORRELATION METHOD
C. Fuglesang Jun. 1987 17 p
(USIP-87-12; ETN-88-91671) Avail: NTIS HC A03/MF A01

It is shown that the method of studying particle correlations, using gaps between particles in rapidity or pseudo-rapidity containing a fixed number of particles, is biased. Corrections have to be done, at least when the data samples are small. It is shown how these corrections were carried out on data from proton-antiproton collisions at 200, 546, and 900 GeV. ESA

N88-17464# National Bureau of Standards, Gaithersburg, Md. Center for Radiation Research.
TECHNICAL ACTIVITIES 1987, CENTER FOR RADIATION RESEARCH
C. E. Kuyatt Oct. 1987 267 p
(PB88-129325; NBSIR-87/3571) Avail: NTIS HC A12/MF A01 CSCL 20H

The report summarizes research projects, measurement method development, calibration and testing, and data evaluation techniques carried out during Fiscal Year 1987 in the NBS Center for Radiation Research. These activities fall in the area of atomic and plasma radiation, radiation physics, radiometric physics,

radiation sources and instrumentation, ionizing radiation, and nuclear physics. GRA

N88-17465# Argonne National Lab., Ill.
TIME DEPENDENT DEGRADATION OF ENERGETIC ELECTRONS IN GASEOUS AND CONDENSED MEDIA
M. Dillon and M. Kimura 1987 5 p Presented at the 8th International Congress of Radiation Research, Edinburgh, United Kingdom, 19 Jul. 1987
(Contract W-31-109-eng-38)
(DE88-002912; CONF-870701-11) Avail: NTIS HC A02/MF A01

A transport equation formulated by Spencer and Fano has been used to calculate initial yields of products formed by electron interactions under conditions of steady state irradiation. Since experimental observation of initial yields may now be possible it is desirable to generalize the treatment of Spencer and Fano to include transient effects explicitly. DOE

N88-17466# Argonne National Lab., Ill.
INTRODUCTORY REVIEW: PHYSICS OF ELECTRON SLOWING-DOWN PROCESSES
Mitio Inokuti 1987 6 p Presented at the 8th International Congress of Radiation Research, Edinburgh, United Kingdom, 19 Jul. 1987
(Contract W-31-109-eng-38)
(DE88-002918; CONF-870701-10) Avail: NTIS HC A02/MF A01

This paper briefly discusses selected topics on the physics of electron slowing-down processes. Included are: new developments in electron degradation theory; the behavior of electrons in solid films; and analysis of the energy spectra of electrons ejected from solid surfaces. DOE

N88-17467# Argonne National Lab., Ill.
DETERMINATION OF MOLECULAR-ION STRUCTURES THROUGH THE USE OF ACCELERATED BEAMS
D. S. Gemmell 1987 6 p Presented at the Meeting on Applications of Ion Beams To Solid State Physics, Osaka, Japan, 9 Oct. 1987
(Contract W-31-109-eng-38)
(DE88-002960; CONF-8710224-1) Avail: NTIS HC A02/MF A01

In this talk we report on recent research on molecular-ion structures using fast molecular-ion beams provided by Argonne's 5-MV Dynamitron accelerator. The method has become known as the Coulomb-explosion technique. When molecular-ion projectiles travelling at velocities of a few percent of the velocity of light strike a foil, the electrons that bind the molecular projectiles are almost always totally stripped off within the first few Angstroms of penetration into the solid target. This leaves a cluster of bare (or nearly bare) nuclei which separate rapidly as a result of their mutual Coulomb repulsion. This violent dissociation process in which the initial electrostatic potential energy is converted into kinetic energy of relative motion in the center-of-mass, was termed a Coulomb explosion. DOE

N88-17468# Argonne National Lab., Ill.
PHOTOIONIZATION DYNAMICS OF EXCITED MOLECULAR STATES
J. L. Dehmer, M. A. OHalloran, F. S. Tomkins, P. M. Dehmer, and S. T. Pratt 1987 15 p Presented at the International Electron Molecule Scattering and Photoionization Meeting, Daresbury, United Kingdom, 18 Jul. 1987
(Contract W-31-109-eng-38)
(DE88-002982; CONF-8707133-1) Avail: NTIS HC A03

Resonance Enhanced Multiphoton Ionization (REMPI) utilizes tunable dye lasers to ionize an atom or molecule by first preparing an excited state by multiphoton absorption and then ionizing that state before it can decay. This process is highly selective with respect to both the initial and resonant intermediate states of the target, and it can be extremely sensitive. In addition, the products of the REMPI process can be detected as needed by analyzing the resulting electrons, ions, fluorescence, or by additional REMPI. This points to a number of opportunities for exploring excited state physics and chemistry at the quantum-state-specific level. Here we will first give a brief overview of the large variety of experimental approaches to excited state phenomena made possible by REMPI. Then we will examine in more detail, recent studies of the three photon resonant, four photon (3 + 1) ionization of H sub 2 via the C(l) sub pi sub u state. Strong non-Franck-Condon behavior in the photoelectron spectra of this nominally simple Rydberg state has led to the examination of a variety of dynamical mechanisms. Of these, the role of doubly excited autoionizing states now seems decisive. Progress on photoelectron studies of autoionizing states in H sub 2 , excited in a (2 + 1) REMPI process via the E,F(l) sub sigma plus sub g will also be briefly discussed. DOE

N88-17469 Illinois Univ. at Urbana-Champaign, Savoy.
NEUTRON AND X-RAY SCATTERING STUDIES OF LAYERED SOLIDS Ph.D. Thesis
Dan Alan Neumann 1987 256 p
Avail: Univ. Microfilms Order No. DA8721723

Inelastic and quasielastic neutron scattering studies of graphite intercalation compounds and X-ray scattering studies of semiconductor films and superlattices which were grown by molecular beam epitaxy are reported. For graphite intercalation compounds, these include measurements of the (001) longitudinal phonons in the ternary compounds K1-xRbxC8 and KC24(ND3)x. The results for the K-Rb compound show an anomalous softening of the compressional elastic constant C33. This stage 1 system also displays one optic mode behavior which can be described by a simple virtual crystal model. No local or gap modes were observed. The acoustic branch of the stage 1 K-ammonia ternary shows a splitting due to coupling of these phonons to a dispersionless librational excitation of the ammonia molecules. The X-ray scattering results involve two types of systems: GaAs grown on Si and Ge substrates and terraced superlattices. First, it is shown that the polar semiconductor GaAs can be grown free from antiphase domains on non-polar Si and Ge substrates. Then the phenomena of terracing for both unstrained and strained layer supperlattices is described. Dissert. Abstr.

73 NUCLEAR AND HIGH-ENERGY PHYSICS

Includes elementary and nuclear particles; and reactor theory.

For space radiation see *93 Space Radiation.*

N88-17470# Continuous Electron Beam Accelerator Facility, Newport New, Va.
CEBAF DESIGN OVERVIEW AND PROJECT STATUS
Christoph Leemann 1988 24 p
(Contract DE-AC05-84ER-4015)
(CEBAF-PR-88-001) Avail: NTIS HC A03/MF A01

The Continuous Electron Beam Accelerator Facility (CEBAF) will be an electron accelerator facility for nuclear physics research providing continuous beams with energies up to at least 4 GeV and currents up to 200 microA. Recirculating Linac concept; beam performance objectives; design choices; system highlights; acceleration systems; beam transport; construction progress; and recent accomplishments are discussed. B.G.

N88-17471# Kernforschungszentrum, Karlsruhe (West Germany). Inst. fuer Reaktorentwicklung.
THREE DIMENSIONAL MONTE CARLO SIMULATION OF MOLECULAR MOVEMENT AND HEAT RADIATION IN VACUUM DEVICES: COMPUTER CODE MOVAK3D
G. Class Jul. 1987 62 p In GERMAN; ENGLISH summary
(KfK-4292; ISSN-0303-4003; ETN-88-91431) Avail: NTIS HC A04/MF A01

A program to simulate gas motion and shine through of thermal radiation in fusion reactor vacuum flow channels was developed.

The inner surface of the flow channel is described by plane areas (triangles, parallelograms) and by surfaces of revolution. By introducing control planes in the flow path, a variance reduction and shortening of the computation, respectively, are achieved through particle splitting and Russian roulette. The code is written in PL/I and verified using published data. Computer aided input of model data is performed interactively either under IBM-TSO or at a microprocessor (IBM PC-AT). The data files are exchangeable between the IBM-mainframe and IBM-PC computers. Both computers can produce plots of the elaborated channel model. For testing, the simulating computation can likewise be run interactively, whereas the production computation can be issued batchwise. The results of code verification are explained, and examples of channel models and of the interactive mode are given. ESA

N88-17472# Stuttgart Univ. (West Germany). Inst. fuer Kernenergetik und Energiesysteme.
A MODEL FOR STATIONARY AND DYNAMIC IMPRESSION OF UNDERCOOLED BOILING IN COUPLED THERMOHYDRAULIC AND NEUTRON PHYSICS CALCULATIONS OF NUCLEAR REACTORS Ph.D. Thesis [EIN MODELL ZUR STATIONAEREN UND DYNAMISCHEN ERFASSUNG DES UNTERKUEHLTEN SIEDENS BEI DER GEKOPPELTEN THERMOHYDRAULISCHEN UND NEUTRONENPHYSIKALISCHEN BERECHNUNG VON KERNREAKTOREN]
Roland Guenther Mueller Jun. 1987 150 p In GERMAN; ENGLISH summary
(IKE-6-171; ISSN-0173-6892; ETN-88-91466) Avail: NTIS HC A07/MF A01

In order to account for subcooled boiling in calculations of neutron physics and thermal hydraulics of light water reactors (where vapor bubbles strongly influence the nuclear chain reaction), a dynamic model is derived from the time-dependent conservation equations. It contains methods for the time-dependent determination of evaporation and condensation heat flow and for the heat transfer coefficient in subcooled boiling. It enables the complete two-phase flow region to be treated consistently. The calculation model was verified using measured data of experiments covering a wide range of thermodynamic boundary conditions. In all cases very good agreement is reached. The results from the coupling of the new calculation model with a neutron kinetics program proves its suitability for the steady-state and transient calculation of reactor cores. ESA

N88-17473# Centro Informazioni Studi Esperienze, Milan (Italy).
THE DISHOMOGENEITY OF THE DEGREE OF SENSITIZATION IN LARGE RECIRCULATION PIPES IN BOILING WATER REACTOR (BWR) POWER PLANTS
A. Benvenuti, S. Bonato, F. Bregani (Ente Nazionale per l'Energia Elettrica, Milan, Italy), R. Pascali, and F. Uberti 1987 12 p Presented at the European Corrosion (EUROCORR) Meeting, Karlsruhe, Fed. Republic of Germany, 6-10 Apr. 1987
(Contract ENEL-ISMAT-200-7093100)
(CISE-3955; ETN-88-91649) Avail: NTIS HC A03/MF A01

Sensitization, considered as Cr depletion at the grain boundary of 28 in. BWR pipes and special pieces was studied. Degree of sensitization (DOS) of material on welded joints, thermally treated, was evaluated. The influence of microstructural dishomogeneity and cold working on sensitization mechanism is reported. The welding process seems to be responsible for the large dishomogeneities of DOS values at the inner surface of the bend. However, DOS decreases as the distance from the inner surface increases. The lower carbon content in the pipe inhibits sensitization during welding. Martensite originated at the inner surface by cold working prior to welding, undergoes severe sensitization at 500 C at the bend side; at the pipe side, sensitization is much less evident. Ferrite distribution affects the sensitization process, but its influence depends also on the carbon content. ESA

N88-17474# Lawrence Livermore National Lab., Calif.
INTENSE ELECTRON BEAMS
S. S. Yu 20 Oct. 1987 11 p Presented at the US-CERN Topical Course on Frontiers of Particle Beams, South Padre Island, Tex., 23 Oct. 1987
(Contract W-7405-eng-48)
(DE88-002456; UCRL-97530; CONF-8710228-1) Avail: NTIS HC A03/MF A01

This paper is concerned with intense electron beams, typically of the order of a few kA in current and up to tens of MeV in beam energy. A beam of this kind can be produced from induction machines, examples of which are the ERA (4 MeV, 1 kA) at Lawrence Berkeley Laboratory and the ASTRON (5 MeV, 500A), ETA (5 MeV, 10 kA), and ATA (50 MeV, 10 kA) at Lawrence Livermore National Laboratory (LLNL). The emphasis of the paper is on the characteristics of these beams and some applications. DOE

N88-17475# Pacific Northwest Labs., Richland, Wash.
TWO-PHASE REDUCED GRAVITY EXPERIMENTS FOR A SPACE REACTOR DESIGN
Z. I. Antoniak 1986 9 p Presented at the Microgravity Fluid Management Symposium, Cleveland, Ohio, 9 Sep. 1986
(Contract DE-AC06-76RL-01830)
(DE86-015530; PNL-SA-14228; CONF-8609146-1) Avail: NTIS HC A02/MF A01

Future space missions envision the use of large nuclear reactors utilizing either a single or a two-phase alkali-metal working fluid. The design and analysis of such reactors require state-of-the-art computer codes that can properly treat alkali-metal flow and heat transfer in a reduced-gravity environment. Flow regime maps, models, and correlations are required if the codes are to be successfully applied to reduced-gravity flow and heat transfer. General plans are put forth for the reduced-gravity experiments which will have to be performed, at NASA facilities, with benign fluids. Data from the reduced-gravity experiments with innocuous fluids are to be combined with normal gravity data from two-phase alkali-metal experiments. Because these reduced-gravity experiments will be very basic, and will employ small test loops of simple geometry, a large measure of commonality exists between them and experiments planned by other organizations. It is recommended that a committee be formed, to coordinate all ongoing and planned reduced gravity flow experiments. DOE

74 OPTICS

Includes light phenomena; and optical devices.
For lasers see *36 Lasers and Masers.*

N88-17476# Duke Univ., Durham, N. C.
THE ROLE OF PHOTODETECTORS IN OPTICAL SIGNAL PROCESSING Final Report, 4 Nov. 1985 - 3 Nov. 1986
G. W. Anderson, B. D. Guenther, J. A. Hynecek, R. J. Keyes, and A. VanderLugt 13 Oct. 1987 47 p
(Contract DAAL03-86-C-0006)
(AD-A186804; ARO-23620.1-PH) Avail: NTIS HC A03/MF A01 CSCL 17E

Optical signal processing applications place demands on photodetector arrays beyond those encountered in image sensing applications. We review the basic requirements and show that increased dynamic range and non-linear decision operations that lead to reduced output data rates are the key improvements needed for both one and two dimensional arrays. Arrays of high-speed photodetector elements, with integrated post-detection circuitry, are also needed. We suggest some possible methods for achieving these goals; our main objective is to stimulate the photodetector community to design and fabricate more useful devices. GRA

N88-17477# Naval Postgraduate School, Monterey, Calif.
CODE DIVISION MULTIPLE ACCESS APPLIED TO FIBER OPTIC DATA TRANSMISSION M.S. Thesis
Tracey A. Fischer Sep. 1987 63 p
(AD-A186873) Avail: NTIS HC A04/MF A01 CSCL 20F

The potential for applying Code Division Multiple Access (CDMA) techniques to achieve simultaneous multichannel data transmission

over a fiber optic data link is investigated. Initially, a slow speed data link at 1 kilobits per second is examined to verify the ability to perform data correlation on a two data stream system. Finally, a design for a high speed link operating at 166.7 kilobits per second is proposed. GRA

N88-17478# York Univ., Toronto (Ontario). Dept. of Chemistry.
RE-USABLE THIN-LAYER SPECTROELECTROCHEMICAL CELL FOR NON-AQUEOUS SOLVENT SYSTEMS Technical Report, Aug. 1987
W. A. Nevin and A. B. Lever Nov. 1987 28 p
(Contract N00014-84-G-0201)
(AD-A186951; TR-19) Avail: NTIS HC A03/MF A01 CSCL 07D

A thin layer spectroelectrochemical cell for use with aqueous or organic solvent systems is described and evaluated. The cell design, comprising a working chamber formed by sandwiching Teflon spacers between two optical windows and a Teflon body, allows versatility of the working electrode material, and is easily dismantled and reassembled. Variation of the window material permits measurements to be made over a wide spectroscopic range, from the UV-visible to the infrared regions. The performance of the cell is assessed for a gold minigrid working electrode in the UV-visible region using the oxidation of 2,9,16,23-tetra(neopentoxy) phthalocyaninato zinc to its pi-cation radical in o-dichlorobenzene, and in the infrared region by investigating the reductions of bis(2,2' bipyridine) (2,2' azodipyridine) ruthenium (II) bis(hexafluorophosphate) in deuterated dimenthylsulfoxide. GRA

N88-17479# Chemical Research and Development Center, Aberdeen Proving Ground, Md.
CHRISTIANSEN EFFECT IN INFRARED SPECTRA OF SOIL-DERIVED ATMOSPHERIC DUSTS Technical Report, Jan. 1979 - Dec. 1982
Hugh R. Carlon Sep. 1987 31 p
(AD-A187071; CRDEC-TR-87069) Avail: NTIS HC A03/MF A01 CSCL 04A

The Christiansen effect occurs when a suspension of particles in a transparent medium is observed at a wavelength where the refractive indices of the particles and of the medium are equal, thus producing an optically homogeneous medium with optical bandpass or filter characteristics. It is shown that soil-derived atmospheric dusts and other particulates can exhibit the Christiansen effect at IR wavelengths and that their spectra can be simulated by equivalent, precipitated films of the particulates on optical substrates. Useful approximation equations are given. The implication of these observations should be considered by atmospheric physicists and IR system designers. GRA

N88-17480# British Aerospace Dynamics Group, Bristol (England). Space and Communications Div.
STUDY OF LARGE SOLAR ARRAYS (SOLA). PHASE 2A: AMPLIFYING INFORMATION TO FINAL REPORT (SS/1109) Final Report
Paris, France Jul. 1983 112 p
(Contract ESA-4903/81-NL-JS(SC))
(BAe-SS/1110; ESA-CR(P)-1819-Vol-2; ETN-87-90512) Avail: NTIS HC A06/MF A01

It is shown that it is feasible to manufacture a basic module from which arrays of various sizes can be constructed within acceptable limits defined by power losses and power-to-weight criteria in the range from 150 to 30 kW, in steps of 2 kW, with a choice of low (52 V) or high (156 V) operating voltage levels. This modular design can be extended to provide array system powers up to 60 kW, although above 30 kW only the high voltage operating level is practical, due to the high resistive power losses associated with the length of array, hence harness, required for such operating power levels. Operating levels are 30 W/kg at 15 kW and 42 W/kg at 30 kW. These levels could be increased by optimizing the design for specific operating power levels, but at the expense of modularity. It is unlikely that the 50 W/kg goal can be reached. Author (ESA)

N88-17481# European Space Agency, Paris (France).
COMPARISON OF A FEW METHODS OF RESTORING IMAGES DISTORTED BY ATMOSPHERIC TURBULENCE
Ruy Deron Oct. 1987 195 p Transl. into ENGLISH of Etude Comparative de Quelques Methodes de Restauration d'Images Degradees par la Turbulence Atmospherique (ONERA, Paris, France), 1986 Original language document was announced as N87-26524
(ESA-TT-1065; ONERA-NT-1986-7; ETN-88-91713) Avail: NTIS HC A09/MF A01

The limits of Knox, Thompson, and Bates image restoration methods are defined and the results of each are compared. The experimental verification is done in a one dimensional imaging configuration, in a tank were the optical effects of atmospheric turbulence were simulated. For Knox-Thompson's method the data agrees well with the prediction and the reconstruction of two types of object is satisfactory. For the Knox-Thompson method there are at least 30 photons per speckle, whereas for the Bates method it is of the order of 10. ESA

N88-17482# Max-Planck-Inst. fuer Quantenoptik, Garching (West Germany).
[ACTIVITIES REPORT IN QUANTUM OPTICS] Annual Report, 1984 [JAHRESBERICHT 1984]
Mar. 1985 168 p In GERMAN
(ISSN-0177-0101; ETN-88-91014) Avail: NTIS HC A08/MF A01

Soft X-ray radiation from laser plasmas, intense Planck radiation, X-ray spectroscopy with transmission gratings, simulation of laser-produced shock waves, self-similar expansion in vacuum, radiation hydrodynamics, electronic structure of highly compressed matter, and heavy-ion beams for inertial confinement were investigated, and a high power iodine laser was developed. Laser-spectroscopy experiments, as well as a gravitational wave experiments were conducted. The fundamentals of light-matter interaction and nonlinear dynamics were studied. Many-photon ionization of molecules; spectroscopy of shock pairs; interaction of excited molecules with surfaces; IR laser applications; organic photochemistry with UV lasers; theoretical chemistry; and a ClF laser were investigated. Thin layers, and a high-pressure CO2 laser were studied. ESA

N88-17483# Technische Hochschule, Darmstadt (West Germany). Fachbereich Physik.
OPTIMIZATION OF IMAGING ENERGY FILTERS FOR ANALYTICAL ELECTRON MICROSCOPY Ph.D. Thesis [OPTIMIERUNG ABBILDENDER ENERGIEFILTER FUER DIE ANALYTISCHE ELEKTRONENMIKROSKOPIE]
Stefan Lanio 1986 135 p In GERMAN
(ETN-88-91079) Avail: NTIS HC A07/MF A01

The theory for the calculation of the imaging characteristics of energy filters was developed, and applied to existing systems and for the determination of optimum filters. The precise consideration of the boundary field of the deflection magnet was emphasized. The optical characteristics of first and second order of the Castaing filter were calculated. Alpha and omega filters with simple structure and good spatial and energy resolution were determined as purely magnetic substitute systems for the Zeiss-Castaing filter. The geometry of a completely corrected omega filter was optimized, and the possibility to correct this filter using seven symmetrically arranged, external hexapoles was determined. ESA

N88-17484# Sandia National Labs., Albuquerque, N. Mex.
A FIBER-OPTIC LINK FOR PRESSURE CONTROL OF ION SOURCES
K. L. Black, D. C. Macmillan, and R. Bastasz Aug. 1987 17 p
(Contract DE-AC04-76DR-00789)
(DE88-001782; SAND-87-8216) Avail: NTIS HC A03/MF A01

A fiber-optic link providing high-voltage electrical isolation of pressure gauging and control instrumentation associated with a Colutron ion source has been developed. The link transmitter is connected to the control circuitry and is kept at ground potential. The link receiver/modulator is battery operated and attached to a

piezoelectric valve located on the ion source, all of which can be biased up to 5 kV. Feedback signals sent via the link control the valve so that constant pressure in the ion source is maintained. The link is simple, compact, and enhances ion source stability and ease of operation. DOE

N88-16772# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Test Services Div.
DEVELOPMENT OF INFRARED TECHNIQUES FOR TESTING SPACECRAFT
J. B. Walker *In its* ESA Bulletin No. 25 Feb. 1981 p 47-52 (For primary document see N88-16767 09-12)
Avail: NTIS HC A05/MF A01

N88-17264*# Industrial Technology Inst., Ann Arbor, Mich.
DEVELOPMENT OF MOIRE MACHINE VISION
Kevin G. Harding *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 413-419 (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 20F

N88-17406# Joint Publications Research Service, Arlington, Va.
PARAMETRIC INTERACTION OF OPTICAL MODES IN FIBER-OPTIC LIGHT GUIDE Abstract Only
V. L. Stirzhevskiy, V. A. Fonmaniy, and Yu. N. Yashkir *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 27 Oct. 1987 p 21 Transl. into ENGLISH from Optika i Spektroskopiya (Leningrad, USSR), v. 62, no. 3, Mar. 1987 p 674-677 (For primary document see N88-17395 09-70)
Avail: NTIS HC A04/MF A01

N88-17408# Joint Publications Research Service, Arlington, Va.
OPTICAL FOURIER TRANSFORMATION BY LENSLESS METHOD WITH PERFORATED MASK AND WITH MODIFIED TALBOT INTERFEROMETER FOR ANALYSIS OF INTERFEROGRAMS Abstract Only
A. P. Smirnov *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 27 Oct. 1987 p 23 Transl. into ENGLISH from Optika i Spektroskopiya (Leningrad, USSR), v. 62, no. 3, Mar. 1987 p 636-643 (For primary document see N88-17395 09-70)
Avail: NTIS HC A04/MF A01

N88-17410# Joint Publications Research Service, Arlington, Va.
SCATTERING OF OPTICAL RADIATION BY BURSTING WATER PARTICLES IN FOG Abstract Only
V. I. Kokhanov, M. F. Nebolsin, and L. K. Chistyakova *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 27 Oct. 1987 p 26 Transl. into ENGLISH from Izvestiya Vysshikh Uchebnykh Zavedeniy: Fizika (Tomsk, USSR), v. 30, no. 2, Feb. 1987 p 79-84 (For primary document see N88-17395 09-70)
Avail: NTIS HC A04/MF A01

N88-17429# Joint Publications Research Service, Arlington, Va.
MULTICHANNEL ANISOTROPIC SINGLE-MODE FIBER OPTICS FOR TRANSDUCERS Abstract Only
A. N. Guryanov, D. D. Gusovskiy, G. G. Devyatykh, Ye. M. Dianov, V. B. Neustruyev, and A. M. Prokhorov *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 27 Oct. 1987 p 52-53 Transl. into ENGLISH from Kvantovaya Elektronika (Moscow, USSR), v. 14, no. 3, Mar. 1987 p 609-611 Original language document was announced in IAA as A87-43556 (For primary document see N88-17395 09-70)
Avail: NTIS HC A04/MF A01

N88-17436# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Cologne (West Germany). Inst. fuer Technische Physik.
ENERGY TRANSMISSION USING COHERENT, QUASIMONOCHROMATIC LIGHT BEAMS [ENERGIEUEBERTRAGUNG MIT HILFE KOHAERENTER, QUASIMONOCHROMATISCHER LICHTBUENDEL]
Hans Opower *In its* Scientific Colloquium in Honor of Prof. Dr. Rer. Nat. Hermann L. Jordan Jun. 1987 p 73-89 In GERMAN (For primary document see N88-17432 09-70)
Avail: NTIS HC A07/MF A01; DFVLR, Cologne, Fed. Republic of Germany DM 29

75 PLASMA PHYSICS

Includes magnetohydrodynamics and plasma fusion.

For ionospheric plasmas see *46 Geophysics*. For space plasmas see *90 Astrophysics*.

N88-17485# Comision Nacional de Energia Atomica, Buenos Aires (Argentina). Dept. de Prospectiva y Estudios Especiales.
EXPERIMENTAL STUDY OF THE INITIAL PLASMA FORMATION STAGE IN A LINEAR THETA PINCH OF INVERTED FIELD [ESTUDIO EXPERIMENTAL DE LA ETAPA DE FORMACION DEL PLASMA EN UN THETA PINCH LINEAL DE CAMPO INVERTIDO]
G. C. Casin, R. Alvarez, R. H. Rojkind, and A. B. Rodrigo 1986 87 p In SPANISH
(DE88-700010; CNEA-NT-21/86) Avail: NTIS (US Sales Only) HC A05/MF A01

The initial stage of plasma formation was studied in a linear theta pinch. Experiments were performed to determine the machine operating conditions for good shot-to-shot reproducibility. Spectroscopic measurements of electron density and of electron and ion temperature were made afterwards to characterize the plasma at different stages of its heating process. The results obtained indicate that shot-to-shot reproducibility is strongly influenced by the presence of impurities and by the plasma preionization technique used. Under proper operating conditions, excellent reproducibility was observed. The measured values of the plasma parameters are compatible with those determined for similar machines. DOE

N88-17486# California Univ., Berkeley. Electronics Research Lab.
PLASMA THEORY AND SIMULATION Progress Report No. 3 and 4, 1 Jul. - 31 Dec. 1986
Charles K. Birdsall 31 Dec. 1986 72 p
(Contracts N00014-85-K-0809; DE-FG03-86ER-53220; DA Proj. RR0-109)
(AD-A187100) Avail: NTIS HC A04/MF A01 CSCL 20I

The Pierce diode linear behavior with external R, C, or L was verified very accurately by particle simulation. The Pierce diode non-linear equilibria with R, C, or L are described theoretically and explored via computer simulation. A simple model of the sheath outside the separatrix of an FRC was modeled electrostatically in 2d and large potentials due to the magnetic well and peak which were found. These may explain the anomalously high ion confinement in the FRC edge layer. A planar plasma source with cold ions and warm electrons produces a source sheath with sufficient potential drop to accelerate ions to sound velocity, which obviates the need for a Bohm pre-collector-sheath electric field. Final reports were prepared for collector sheath, presheath, and source sheath in a collisionless, finite ion temperature plasma; potential drop and transport in a bounded plasma with ion reflection at the collector; potential drop and transport in a bounded plasma with secondary electron emission at the collector. A movie has been made displaying the long-lived vortices resulting from the Kelvin-Helmholtz instability in a magnetized sheath. A relativistic Monte Carlo binary (Coulomb) collision model has been developed and tested for inclusion into the electrostatic particle simulation code TESS. Two direct implicit time integration schemes are tested

for self-heating and self-cooling and regions of neither are found as a function of delta t and delta x for the model of a freely expanding plasma slab. GRA

N88-17487# Lawrence Livermore National Lab., Calif.
MICROWAVE SYSTEM FOR THE MICROWAVE TOKAMAK EXPERIMENT (MTX)
B. Felker, W. Ferguson, J. Heefner, K. Krause, M. Makowski, and R. Yamamoto Oct. 1987 5 p Presented at the 12th Symposium on Fusion Engineering, Monterey, Calif., 12-16 Oct. 1987
(Contract W-7405-eng-48)
(DE88-002391; UCRL-97461; CONF-871007-66) Avail: NTIS HC A02/MF A01

The microwave system for the Microwave Tokamak Experiment (MTX) will include part of the Lower Hybrid Heating (LHH) system used at Massachusetts Institute of Technology (MIT) on the Alcator machine and the new Free Electron Laser (FEL) microwave system being developed at LLNL. The LHH system for MTX will be two carts of four klystrons, each with a nominal total power of 2.1 MW at 4.6 GHz. The FEL system will deliver 2-MW average power at 250 GHz. 50 ns pulses every 200 microsec of 8 gigawatt peak power will deliver the 2-MW average power. This paper will present both the LHH system from MIT and the FEL transmission system, which includes the master oscillator, launch into the FEL, mirrors, and transport system into the MTX. The microwave transmission system, microwave beam diagnostics, present design status, and other related issues will be presented. The MTX joins two devices, ETA-II and Alcator-C, through a beamline. DOE

N88-17488# North Carolina Univ., Chapel Hill. Dept. of Statistics.
ERROR MODELING AND CONFIDENCE INTERVAL ESTIMATION FOR INDUCTIVELY COUPLED PLASMA CALIBRATION CURVES Journal Report, Aug. 1986 - Aug. 1987
Robert L. Watters, Jr., Raymond J. Carroll, and Clifford H. Spiegelman (National Bureau of Standards, Washington, D.C.) Feb. 1987 29 p
(Contract F49620-85-C-0144)
(AD-A186711; MIMEO SER-1715; AFOSR-87-1098TR) Avail: NTIS HC A03/MF A01 CSCL 20I

A simple linear calibration function can be used over a wide concentration range for the Inductively Coupled Plasma (ICP) spectrometer due to its linear responses. The random errors over wide concentration ranges are not constant, and constant variance regression should not be used to estimate the calibration function. Weighted regression techniques are appropriate if the proper weights can be obtained. Use of the calibration curve to estimate the concentration of one or more unknown samples is straightforward, but confidence interval estimation for multiple use of the calibration curve is less obvious. A method is described for modeling the error along the ICP calibration curve using the estimated parameters from the fitted model to calculate weights for the calibration curve fit. Multiple and single-use confidence interval estimates are obtained and results along the calibration curve are compared. GRA

N88-17489# United Technologies Research Center, East Hartford, Conn.
EXCIMER PLASMA DISPLAYS Final Report, 15 Apr. 1983 - 14 Sep. 1987
F. A. Otter, Jr. and W. L. Nighan 14 Sep. 1987 63 p
(Contract DAAG29-83-C-0013)
(AD-A186731; UTRC-R87-926489-9; ARO-19508.2-PH) Avail: NTIS HC A04/MF A01 CSCL 20I

An investigation of the feasibility of utilizing visible excimer molecule fluorescence as a medium for flat panel plasma displays is discussed. Because large area ac plasma panels based on the Owens-Illinois Digivue design are the industry standard, panels of that type were used for test purposes throughout the program. The single most significant outcome of this research was the demonstration that visible fluorescence from XeO and XeF excimers can be generated at a luminance level equivalent to that of the standard Ne-Penning mixture, albeit at a lower luminance efficiency. It was found that a variety of colors, varying continuously from pink through white to blue, can be produced by combining neon line emission with broadband XeF emission in a mixture comprised of Ne, Xe, F2 and Kr. A specific color or white is obtained by changing the relative proportions of the rare gas mixture constituents. The ability of XeF-based mixtures to produce emission over a large portion of the visible spectrum suggests that color ac plasma panels may be possible through use of an optical switching device or using an array of micro-filters to form a pixel. GRA

N88-17490# Royal Inst. of Tech., Stockholm (Sweden). Dept. of Plasma Physics and Fusion Research.
BETA LIMITATION OF MATTER-ANTIMATTER BOUNDARY LAYERS
B. Lehnert Aug. 1987 16 p
(TRITA-EPP-87-11; ISSN-0348-7539; ETN-88-91680) Avail: NTIS HC A03/MF A01

A model for a boundary layer which separates a cloud of matter from one of antimatter in a magnetized ambiplasma, in which steady pressure equilibrium ceases to exist when a certain beta limit is exceeded is discussed. The latter is defined as the ratio between the ambiplasma and magnetic field pressures which balance each other in the boundary layer. Thus, at an increasing density, the high-energy particles created by annihilation within the layer are pumped up to a pressure which cannot be balanced by a given magnetic field. The boundary layer then disrupts. The critical beta limit thus obtained falls within the observed parameter ranges of galaxies and other large cosmical objects. Provided the matter-antimatter balance holds true, this limit is expected to impose certain existence conditions on matter-antimatter boundary layers. Such a limitation may apply to cosmical objects and cosmological models. The maximum time scale for the corresponding disruption development is 0.0001 to 100 sec for boundary layers at ambiplasma particle densities from 10,000 to 0.1/cu m, respectively. ESA

N88-17491# Royal Inst. of Tech., Stockholm (Sweden). Dept. of Plasma Physics.
CRITICAL IONIZATION VELOCITY (CIV) INTERACTION: SOME UNSOLVED QUESTIONS
N. Brenning and I. Axnaes Sep. 1987 32 p Submitted for publication Sponsored by the Swedish Natural Science Research Council
(TRITA-EPP-87-12; ISSN-0348-7539; ETN-88-91681) Avail: NTIS HC A03/MF A01

Critical ionization velocity, magnetic field strength, geometry, neutral gas density, and time duration are reviewed. Experiments and theories (microscopic and macroscopic) are discussed. ESA

N88-17492# Royal Inst. of Tech., Stockholm (Sweden). Dept. of Plasma Physics.
DYNAMICAL ASPECTS OF ELECTROSTATIC DOUBLE LAYERS
M. A. Raadu and J. J. Rasmussen Sep. 1987 62 p Submitted for publication
(TRITA-EPP-87-13; ISSN-0348-7539; ETN-88-91682) Avail: NTIS HC A04/MF A01

Theoretical models of different types of double layers are discussed. It is shown that the existence conditions often imply current driven instabilities in the ambient plasma, at least for strong double layers, and it is argued that such conditions must be used with care when applied to real plasmas. Laboratory double layers, and by implication those arising in astrophysical plasmas, often produce instabilities in the surrounding plasma and are generally time dependent structures. Naturally occurring double layers should therefore be far more common than the restrictions deduced from idealized time independent models imply. The dynamics of weak double layers are reviewed. A model for a moving strong double layer, where an associated potential minimum plays a significant role, is presented. ESA

N88-17493# Stuttgart Univ. (West Germany). Inst. fuer Plasmaforschung.

INVESTIGATION OF THE EVOLUTION OF THE FUSION PROCESSES IN THE PLASMA FOCUS USING TIME-RESOLVED NEUTRON SPECTROSCOPY [UNTERSUCHUNG UEBER DEN ABLAUF DER FUSIONSPROZESSE IM PLASMAFOKUS UNTER VERWENDUNG VON ZEITAUFGELOESTER NEUTRONEN-SPEKTROSKOPIE]

Reiner Schmidt Jan. 1987 129 p In GERMAN; ENGLISH summary

(IPF-87-4; ETN-88-91019) Avail: NTIS HC A07/MF A01

The temporal evolution of the fusion processes in the plasma focus POSEIDON was investigated by the diagnosis of the fusion neutrons. Neutron production during the quiescent and the turbulent phases was studied by time-resolved analysis of the neutron anisotropy factor, and by time and space resolved measurements of neutron emission. Time resolved spectral distributions of fusion neutrons were obtained by an extension of time of flight spectroscopy. During both phases there exists a nonthermal neutron production. The deuteron acceleration mechanisms, responsible for the production processes in both phases are discussed. ESA

N88-17494# Los Alamos National Lab., N. Mex.

PROCEEDINGS OF THE INTERNATIONAL WORKSHOP ON ENGINEERING DESIGN OF NEXT STEP REVERSED FIELD PINCH DEVICES

D. B. Thomson, comp. Nov. 1987 486 p Workshop held in Los Alamos, N. Mex., 13 Jul. 1987

(Contract W-7405-eng-36)

(DE88-001915; LA-11139-C; CONF-8707105) Avail: NTIS HC A21

These Proceedings contain the formal contributed papers, the workshop papers and workshop summaries presented at the International Workshop on Engineering Design of Next Step RFP Devices held at Los Alamos, July 13 to 17, 1987. Contributed papers were presented at formal sessions on the topics: (1) physics overview (3 papers); (2) general overview (3 papers); (3) front-end (9 papers); (4) computer control and data acquisition (1 paper); (5) magnetics (5 papers); and (6) electrical design (9 papers). Informal topical workshop sessions were held on the topics: (1) RFP physics (9 papers); (2) front-end (7 papers); (3) magnetics (3 papers); and (4) electrical design (1 paper). This volume contains the summaries written by the Chairmen of each of the informal topical workshop sessions. The papers in these Proceedings represent a significant review of the status of the technical base for the engineering design of the next step RFP devices being developed in the US, Europe, and Japan, as of this date. DOE

N88-17495# Argonne National Lab., Ill.

THE APPLICATION OF LIQUID-METAL MHD (MAGNETO-HYDRODYNAMICS) TO RENEWABLE ENERGY SOURCES

G. F. Berry, M. Petrick, E. S. Pierson, and S. Sukoriansky 1987 11 p Presented at the 25th Symposium on Engineering Aspects of Magnetohydrodynamics, Bethesda, Md., 24 Jun. 1987 Prepared in cooperation with Purdue Univ., Hammond, Ind. and Ben-Gurion Univ. of the Negev, Beersheba, Israel

(Contract W-31-109-eng-38)

(DE88-003083; CONF-870664-4) Avail: NTIS HC A03

A system study of the OMACON liquid-metal MHD conversion technology was undertaken for SCE to define the potential gains that could be derived from the use of the technology in selected utility applications. Four applications studied were: (1) the solar power tower; (2) a medium temperature solar system employing line focus collectors; (3) geothermal power systems; and (4) an Integrated Coal-Gasifier Combined Cycle plant. Computer simulations were developed for each of the system applications and used to calculate thermodynamic performance; the computer simulations were also used to evaluate sensitivity of system performance to key component efficiencies and operating parameters. The computer simulations accounted for all known first-order loss mechanisms. Only the solar power tower and geothermal power system are presented in this paper. DOE

N88-17496# Oak Ridge National Lab., Tenn.

INFLUENCE OF FAST ALPHA DIFFUSION AND THERMAL ALPHA BUILDUP ON TOKAMAK REACTOR PERFORMANCE

N. A. Uckan, J. S. Tolliver, W. A. Houlberg, and S. E. Attenberger Nov. 1987 37 p Presented at the Workshop on Alpha Particle Effects in ETR, Washington, D.C., 15 Jun. 1987

(Contract DE-AC05-84OR-21400)

(DE88-003661; ORNL/TM-10612; CONF-8706119-3) Avail: NTIS HC A03/MF A01

The effect of fast alpha diffusion and thermal alpha accumulation on the confinement capability of a candidate Engineering Test Reactor (ETR) plasma (Tokamak Ignition/Burn Experimental Reactor (TIBER-II)) in achieving ignition and steady-state driven operation was assessed using both global and 1-1/2-D transport models. Estimates are made of the threshold for radial diffusion of fast alphas and thermal alpha buildup. It is shown that a relatively low level of radial transport, when combined with large gradients in the fast alpha density, leads to a significant radial flow with a deleterious effect on plasma performance. Similarly, modest levels of thermal alpha concentration significantly influence the ignition and steady-state burn capability. DOE

N88-17497# Japan Atomic Energy Research Inst., Tokyo.

TWO-DIMENSIONAL ANALYSIS FOR A SCRAPEOFF AND DIVERTOR REGIONS WITH AN MHD MODEL. CONCEPTUAL DESIGN STUDY OF FY86 FER

Noriaki Ueda, Masao Kasai, and Shigehisa Hitoki Aug. 1987 22 p

(DE88-751069; JAERI-M-87-119) Avail: NTIS (US Sales Only) HC A03/MF A01

With a two-dimensional time dependent fluid code for transport processes in the edge plasma in a Tokamak, coupled with Monte-Carlo method for neutral gas behavior, preliminary numerical study was carried out for the Fusion Experimental Reactor (FER) divertor. Design base data such as energy flux, particle flux and so on which are essentially important to make an divertor design reliable were obtained. DOE

N88-17498# Los Alamos National Lab., N. Mex.

THE TITAN REVERSED-FIELD PINCH REACTOR: DESIGN-POINT DETERMINATION AND PARAMETRIC STUDIES

R. L. Miller 1987 10 p Presented at the 12th Symposium on Fusion Engineering, Monterey, California, 12 Oct. 1987

(Contract W-7405-eng-36)

(DE88-001824; LA-UR-87-3465; CONF-871007-40) Avail: NTIS HC A02/MF A01

The multi-institutional TITAN study has examined the physics, technology, safety, and economics issues associated with the operation of a Reversed-Field Pinch (RFP) magnetic fusion reactor at high power density. A comprehensive system and trade study were conducted as an integral and ongoing part of the reactor assessment. Attractive design points emerging from these parametric studies are subjected to more detailed analysis and design integration, the results of which are used to refine the parametric systems model. The design points and tradeoffs for two TITAN/RFP reactor embodiments are discussed. DOE

N88-17499# Brookhaven National Lab., Upton, N. Y.

THE APPROACH TO EQUILIBRIUM IN A QUARK-GLUON PLASMA

U. Heinz 1987 13 p Presented at the 6th International Conference on Ultrarelativistic Nucleus-Nucleus Collisions, Nordkirchen, Fed. Republic of Germany, 24 Aug. 1987

(Contract DE-AC02-76CH-00016)

(DE88-002117; BNL-40359; CONF-8708166-2) Avail: NTIS HC A03/MF A01

The basic questions to be addressed in this paper are: How does the quark-gluon plasma, once formed in heavy-ion collisions, approach equilibrium. What are the basic equilibrium time scales -

how do they compare with the plasma lifetime before hadronization and freeze-out set in. In particular, how do the strong color anisotropies, which are presumably present in the initial formation stage disappear and how fast, if at all, do the color degrees of freedom attain local equilibrium. The approach that I wish to present here involves the following chain of arguments: equilibration is related to dissipation of energy and creation of entropy; it is determined by the dissipative, i.e., imaginary part of certain response functions - for example, to calculate the rate of dissipation for a density perturbation in an equilibrium plasma we need to work out the imaginary part of the retarded density-density correlation function; this imaginary part of the response function is dominated by its poles which signal collective modes - for example, phonons in the density-density correlation function, (colored) plasmons in the electric and magnetic response functions, etc.; from the imaginary part one can calculate a damping rate gamma for these collective modes which in turn yields an estimate for the equilibration time scale tau/sub equ/ is approximately h-bar/gamma. In this contribution I will concentrate on color equilibration and thus focus on color electric and magnetic plasma oscillations and their damping rates. DOE

N88-17500# Oak Ridge National Lab., Tenn.
MODELING CONSIDERATIONS FOR SELECTED rf-PLASMA EDGE EFFECTS
J. T. Hogan 1987 18 p Presented at the ICRF/Edge Physics Workshop, Oak Ridge, Tenn., 6 Oct. 1987
(Contract DE-AC05-84OR-21400)
(DE88-003285; CONF-8710215-1-Vugraphs) Avail: NTIS HC A03/MF A01

This paper contains viewgraphs on the following topics: SOL modeling in iron core machines requiring a two-dimensional description; charge exchange of H° with carbon of rf antennas; and self-sputtering of antennas by emitted and sheath-accelerated carbon and Textor/Tore Supra Tokamak plasma edge effect models. DOE

N88-17501# Nagoya Univ. (Japan). Inst. of Plasma Physics.
TOTAL AND PARTIAL CROSS SECTIONS FOR ELECTRON CAPTURE FOR C(q+) (q=6-2) AND O(q+) (q=8-2) IONS IN COLLISIONS WITH H, H2 AND He ATOMS
H. Tawara Oct. 1987 179 p
(IPPJ-AM-56) Avail: NTIS HC A09/MF A01

Experimental and theoretical total and partial cross sections for single and double electron capture of C sup q+ and O sup q+ ions in collision with H, H2, and He targets are surveyed. Present available dat for these ions are summarized in tables. Author

N88-17502# Nagoya Univ. (Japan). Inst. of Plasma Physics.
ATOMIC DATA FOR HYDROGENS IN COLLISIONS WITH ELECTRONS: ADDENDA
H. Tawara, Y. Itikawa, H. Nishimura, and M. Yoshino Oct. 1987 45 p Supplement to IPPJ-AM-46: See N87-14163
(IPPJ-AM-55-Add) Avail: NTIS HC A03/MF A01

Characteristics of hydrogen atoms and ions produced through the dissociation or excitation of hydrogen molecules by electron impact are surveyed. B.G.

N88-17503# Nagoya Univ. (Japan). Inst. of Plasma Physics.
OBSERVATION OF ENHANCED ELECTRIC FIELD IN AN RF-PLUGGED SHEET PLASMA IN THE RFC-XX-M OPEN-ENDED MACHINE
T. Oda, K. Kadota, K. Takiyama, M. Hamamoto, T. Ohgo (Fukuoka Univ. of Education, Munakata, Japan), K. Adati, J. Fujita, R. Kumazawa, S. Okamura, and T. Sato et al. Dec. 1987 16 p
(IPPJ-857; ISSN-0469-4732) Avail: NTIS HC A03/MF A01

Nonperturbing observation of the electric field in the sheet plasma for an RF end-plugging on the RFC XX-M open-ended machine is reported, using the Stark effect with a combined technique of beam-probe and laser-induced fluorescence. Under optimum conditions RF plugging, an enhanced electric field is found in the sheet plasma by about 2.5 times with respect to the electric field when no plasma is produced. The field spatial profile is also measured, which is diagnosed in connection with the electrostatic eigenmode. Author

N88-17504# Nagoya Univ. (Japan). Inst. of Plasma Physics.
MAGNETO-INERTIA CONFINEMENT APPROACH (MICA) TO FUSION IN DYNAMIC Z-PINCH FORMED FROM A FROZEN DEUTERIUM-TRITIUM TUBE
Kazunari Ikuta Nov. 1987 11 p
(IPPJ-856; ISSN-0469-4732) Avail: NTIS HC A03/MF A01

The magneto-inertial confinement approach to fusion in a dynamic z-pinch regime is reconsidered using a new method of generating a hot plasma using a frozen deuterium tube as an initial condition. It will be seen that the technology of fabricating deuterium ice tube is possible if available pulse power technology could induce a current on the order of 10 MA along the tube. The dense z-pinch plasma formed from the electromagnetic implosion of this tubular deuterium-tritium ice with a radius of approximately 1 mm can satisfy the Lawson criterion, provided that its length is 1 cm. Author

N88-17505# Nagoya Univ. (Japan). Inst. of Plasma Physics.
OPTIMIZATION OF VOLUME PRODUCED H(-) IONS IN A LOW-PRESSURE HYDROGEN PLASMA
Osamu Fukumasa, Setsuo Saeki, and Shigeru Shiratake Nov. 1987 44 p
(IPPJ-853; ISSN-0469-4732) Avail: NTIS HC A03/MF A01

Optimization of volume produced H(-) ions is studied by using a set of particle balance equations in a steady state hydrogen plasma with a single chamber system. Dependences of both H(-) and vibrationally excited hydrogen molecules H*2 productions on plasma parameters (i.e., electron temperature T sub e, hydrogen gas pressure p, electron density n sub e, density ratio n sub fe/n sub e of fast electrons e sub f to cold plasma electron e, energy of fast electron E sub fe) are explored because H(-) ions are generated by the following two-step process, i.e., H2 + e sub f yields H*2 + e sub f; H*2 + e yields H(-) + H. Particular attention is also paid to wall effects on H(-) production. The wall recombination coefficient gamma sub 1 for H and the wall de-excitation collision parameter gamma sub 2 are treated as numerical parameters. It is confirmed that the presence of e sub f with energies in excess of 40 eV is essential H(-) production. With increasing T sub e, H(-) yield decreases monotonically. The parameters n sub e, n sub fe/n sub e, and p have some optimum values for H(-) production. These plasma parameter dependences for H(-) ions, namely optimum conditions, are not compatible with those for H*2 formation. Another significant point is that ion species ratios depend strongly on wall parameters. For H(-) production, the optimum condition is that gamma sub 1 is approximately 1 and gamma sub 2 is dominated by 1. Author

N88-17506 California Univ., Los Angeles.
PUMP LIMITER EXPERIMENTS AND ANALYSIS IN THE TEXTOR TOKAMAK Ph.D. Thesis
Gregor Alasdair Campbell 1986 173 p
Avail: Univ. Microfilms Order No. DA8723160

The ALT-1 pump limiter was used effectively for particle control in the TEXTOR tokamak. Two distinctively different pump limiter modules have given markedly different performance. Operation both as the main limiter and in the shadow of the main TEXTOR limiters has allowed evaluation of the pump limiter over a wide range of incident plasma parameters. Incident ion fluxes of up to 9.5 x 10 to the 18th/sq cm/s are measured with langmuir probes mounted on ALT-1. Pressures of up to 3 mtorr are measured in the large ALT-1 vacuum chamber with no active pumping. With active pumping particle removal rates of up to 7 torrl/s are measured. The pressure rise in the pump limiter is strongly dependent on the interaction of neutrals with the edge plasma. The experimental results are found to agree closely with a 3-D Monte Carlo neutral transport code that includes the atomic physics of the plasma-neutral interaction. Langmuir probes mounted directly on the ALT limiter, and a scanning probe located 90 deg toroidally from the limiter are used to characterize the edge plasma. The

edge plasma is characterized by density and flux e-folding lengths of about 1.8 cm when ALT is the main limiter. Dissert. Abstr.

N88-17507# Sociedade Brasileiro de Fisica, Sao Paulo.
PROCEEDINGS OF THE ENERGY INDEPENDENCE CONFERENCE: FUSION ENERGY AND PLASMA PHYSICS
1987 135 p Conference held in Rio de Janeiro, Brazil, 17-21 Aug. 1987
(DE88-700657; INIS-BR-897; CONF-870836) Avail: NTIS (US Sales Only) HC A07/MF A01

Papers on laser fusion, tokamak experiments, magnetic confinement and plasma physics are presented. DOE

76 SOLID-STATE PHYSICS

Includes superconductivity.

For related information, see also *33 Electronics and Electrical Engineering* and *36 Lasers and Masers.*

N88-17508# Massachusetts Inst. of Tech., Lexington. Lincoln Lab.
SOLID STATE RESEARCH Quarterly Technical Report, 1 Nov. 1986 - 31 Jan. 1987
Alan L. McWhorter 15 Feb. 1987 109 p
(Contract F19628-85-C-0002)
(AD-A185987; Rept-1987; Rept-1; ESD-TR-86-176) Avail: NTIS HC A06/MF A01 CSCL 09C

The solid state research work of Lincoln Lab. is covered in detail. The topics covered are Solid State Device research, quantum electronics, materials research, microelectronics, and analog device technology. More specific topics under those headings are: High-Spectral-Purity CW and Pulsed Output from an Ensemble of Discrete Diode Laser; Ohmic Heating in p-Substrate Buried Heterostructure Lasers - An Analytical Solution; Proton Irradiation and Annealing of Fe-Doped Semi-insulating InP 16-Gb/s Large-Signal Digital Modulation of Diode Lasers; Studies of Transient Effects in Ti:Al Laser Tuning; Acousto optic Modulator as a Unidirectional Device in a Ring Laser; Model Locked Ti:Al Laser Injection-Locking a 1.32 micrometers Nd:YAG Laser with a Diode Laser; Generation of Second Harmonic of Nd:YAG Laser Radiation; New System for Zone-Melting Recrystallizations of SOI Films; Diffusion Model for Estimating Interface Widths in Heterostructures Grown in Vertical OMVPE Reactor; Laser Direct-Written Tungsten Microstrip Lines for GaAs Monolithic Microwave Integrated Circuit Trimming. of Cr-CrO Films for Amplitude Compensation of Surface Acoustic Wave Devices; Low-Phase-Noise Oscillators Stabilized by Bulk-Acoustic-Wave Holographic Grating Resonators. E.R.

N88-17509# Naval Ship Research and Development Center, Bethesda, Md.
REACTION MECHANISM OF SULFUR DIOXIDE WITH SINGLE CRYSTAL COBALT AND CHROMIUM AND CoCrAlY COATINGS Final Report, 1 Oct. 1985 - 1 Mar. 1987
Louis F. Aprigliano Sep. 1987 139 p
(AD-A185989; DTNSRDC-87/027) Avail: NTIS HC A07/MF A01 CSCL 11F

The objective of this research was to obtain a basic understanding of the reaction mechanism of sulfur dioxide with cobalt and chromium and to use this understanding to analyze the more complex reaction mechanism of sulfur dioxide with CoCrAlY coatings. A basic premise was that the reaction mechanisms of SO2 with Co and Cr are similar and can be described in two basic steps: SO2 yields 2(O) + (S); and 2(O) + SO2 yields SO4. The first step involves the dissociation of SO2 on the metal surfaces with the resulting formation of sulfides and oxides. In the second step, these oxides provide sites at which additional SO2 can bond to the surface and form sulfates. By using X-ray photoelectron spectroscopy (XPS) to study the reaction of SO2 with oxide-free surfaces of single crystal Co(0001) and Cr(110), these steps were shown to occur. The rates of these reactions were found to be similar for the two metals, and no appreciable difference in activation energies could be determined for the exposure conditions tested. Cluster calculations based on the SCF-X alpha-SW method were used to model the second step of the reaction. The approximate energies of the electrons in a cluster of ten cobalt and two oxygen atoms were calculated, and the electron levels most likely involved in the sulfate formation were identified. Experiments with CoCrAlY coatings showed that sulfates were formed in a manner similar to that described for Co(0001) and Cr(110). It was further demonstrated that as the chromium content increased in the coatings, the formation of cobalt sulfate was reduced; the high-chromium content coating formed sigma phase. M.G.

N88-17510# Naval Postgraduate School, Monterey, Calif.
A REPORT ON THE EFFECTS OF NEUTRON IRRADIATION OF GaAs SEMICONDUCTORS M.S. Thesis
John K. Callahan Jun. 1987 43 p
(AD-A186816) Avail: NTIS HC A03/MF A01 CSCL 20F

The effects of neutron irradiation in GaAs MMICs and small signal FETs were investigated. Carrier concentration and mobility were measured as a function of fluence, doping, and channel depth. The individual components of the MMICs were also measured. Device degradation was determined to be the result of a combination of decreases in carrier concentration and mobility in the FETs. Radiation hardness levels based on 20 percent degradation in gain and drain current were determined. GRA

N88-17511# Rockwell International Corp., Thousand Oaks, Calif. Microelectronics Research and Development Center.
SUPERLATTICE PHOTODETECTORS Final Technical Report, Jul. 1983 - May 1985
Stanley W. Zehr Aug. 1987 56 p
(Contract F19628-83-C-0055)
(AD-A186956; MRDC41140.10FR; RADC-TR-87-102) Avail: NTIS HC A04/MF A01 CSCL 17E

The technical progress in Phase 1 of this two-phase program aimed at development of low noise, high sensitivity superlattice avalanche photodiodes is reported. The initial focus of the Phase 1 effort was development of metalorganic chemical vapor deposition (MOCVD) technology for the growth of high quality GaAs/AlGaAs superlattice structures. Using the developed growth technology, two series of GaAs/AlGaAs structures were evaluated with regard to dark current, breakdown voltage, and dark and illuminated gain characteristics to study effects of variations in critical growth and structural parameters. The results will be used to guide development of a predictive performance model for this class of devices during Phase 2 of the program. The model will then be applied to optimizing design of low noise, high sensitivity InGaAs/InP APD's operating in the low loss 1.0 to 1.6 micrometers wavelength range. Such devices will be grown by MOCVD and their performance evaluated during Phase 2 of the program. GRA

N88-17512# State Univ. of New York, Buffalo. Dept. of Chemistry.
MEMORY EFFECTS ON INFRARED ADSORBATE SPECTRA
Henk F. Arnoldus and Thomas F. George Nov. 1987 10 p
(Contract N00014-86-K-0043)
(AD-A186976; UBUFFALO/DC/87/TR-59) Avail: NTIS HC A02/MF A01 CSCL 20E

A vibrational bond between an adsorbed atom and a crystal can absorb photons from a weak (probe) laser field (frequency omega). The line shape for this process is usually assumed to be a Lorentzian, which reflects that the kinetic coupling to the phonon reservoir is supposed to be a memoryless process. Due to the finite cutoff of the phonon dispersion relation (Debye frequency omega sub D), this is not an accurate approximation if the transition frequency omega sub o between two levels of potential well is of the same order magnitude as omega sub D. A finite memory-time reservoir theory is applied to the evaluation of the line shape, and two distinct properties are found. First, it is shown that the modified Lorentzian is identically zero for omega greater than omega sub D, and then a memory-induced line at omega approx omega sub

o + omega sub D is predicted. The physical origin of these features is explained in terms of energy-conserving diagrams. GRA

N88-17513# Harry Diamond Labs., Adelphi, Md.
DISPERSIVE HOLE TRANSPORT IN SiO2 Final Report, 1978 - 1987
F. B. McLean, H. E. Boesch, Jr., and James M. McGarrity Oct. 1987 57 p
(AD-A187077; HDL-TR-2117) Avail: NTIS HC A04/MF A01 CSCL 07D

A detailed study is presented on the temperature, field, and thickness dependencies of the transient, radiation-induced hole transport in thin films of amorphous SiO2 employed as the gate oxides of metal-oxide-semiconductor (MOS) structures. The samples used in the investigation are clean, radiation-hardened oxides in which less than 2 percent of the holes generated are permanently trapped and therefore are ideal for basic transport studies. The measurements show that for the entire range of temperature (78 to 293 K), field (1 to 6 MV/cm), and thickness (22 to 99 nm) investigated, the time dispersion of the transport can be adequately described by the continuous-time-random-walk (CTRW) model with a single value of the disorder parameter: alpha = 0.25 + or - 0.03. This is a crucial result which indicates rather strict universality of the hole transport with respect to temperature, field, and thickness in clean amorphous SiO2. Changes in these parameters simply affect the time scale for the transport, but not the shape or overall dispersion of the response curves. The observed universality feature has implications for the microscopic basis of the transport, namely that the hole transport proceeds via hopping between localized trapping sites in the SiO2 film, with the dispersion originating primarily from a broad distribution of intersite transfer integrals. GRA

N88-17514# State Univ. of New York, Buffalo. Dept. of Chemistry.
THEORY OF THE TETRAGONAL-TO-ORTHORHOMBIC STRUCTURAL PHASE TRANSITION IN La2CuO4
D. Sahu and Thomas F. George Nov. 1987 13 p
(Contract N00014-86-K-0043)
(AD-A187141; UBUFFALO/DC/87/TR-60) Avail: NTIS HC A03/MF A01 CSCL 07B

A phenomenological free energy for the tetragonal-to-orthorhombic structural phase transition in La2CuO4 is derived from symmetry principles. The critical properties of the model free energy are studied by renormalization group methods and compared with experiment. GRA

N88-17515# California Univ., Berkeley. Lawrence Berkeley Lab. Materials and Chemical Sciences Lab.
STUDIES OF NONLINEAR AND CHAOTIC PHENOMENA IN SOLID STATE SYSTEMS Ph.D. Thesis
Paul Henry Bryant Sep. 1987 251 p
(Contract DE-AC03-76SF-00098)
(DE88-002330; LBL-23975) Avail: NTIS HC A12/MF A01

This thesis contains three sections discussing different areas. Spin wave interactions in iron garnets are described in section one. Mathematical analysis of a magnetic oscillator is presented in section two. In the final section, the source of noise in Josephson Junctions is investigated. The three sections are indexed separately. DOE

N88-17516# Sandia National Labs., Albuquerque, N. Mex.
BULK SUPERCONDUCTIVITY IN La2CuO4
J. E. Schirber, E. L. Venturini, B. Morosin, J. F. Kwak, D. S. Ginley, and R. J. Baughman 1987 7 p Presented at the Fall Meeting of the Materials Research Society, Boston, Mass., 30 Nov. 1987
(Contract DE-AC04-76DP-00789)
(DE88-002509; SAND-87-2668C; CONF-871124-6) Avail: NTIS HC A02/MF A01

In this paper we describe our studies of ceramic samples of La2CuO sub 4-y loaded with oxygen by high pressure. This technique results in substantial incorporation of O2 in the material (of the order of 0.3 to 0.4% by weight) and in gross changes in the bulk resistivity and magnetization as well as discernible changes in the lattice parameters of the material. DOE

N88-17517# Vanderbilt Univ., Nashville, Tenn. Dept. of Mechanical and Materials Engineering.
THE EFFECT OF VARYING SPUTTERING PARAMETERS ON THE MICROSTRUCTURE AND MECHANICAL PROPERTIES OF 10 PERCENT Ni + TiB2 THIN FILMS
R. H. Parrish, J. J. Wert, W. C. Oliver, and P. S. Sklad 1987 8 p Presented at the 7th International Conference on Erosion by Liquid and Solid Impact, Cambridge, United Kingdom, 7 Sep. 1987
(Contract DE-AC05-84OR-21400)
(DE88-002600; CONF-8709188-1) Avail: NTIS HC A02/MF A01

Thin refractory coatings have been demonstrated to deter solid particle erosion. A detailed examination of the microstructures of 10 percent Ni + TiB2 with varying sputtering parameters was undertaken by the use of transmission electron microscopy. Advanced instrumentation was then used to determine the micromechanical and macromechanical properties of these coatings. Microstructures, nanoindentation hardness values and moduli of elasticity were compared to obtain a better understanding of the role of sputtering parameters in determining coating performance. DOE

N88-17518# Xerox Webster Research Center, N.Y.
ELECTRONIC AND CHEMICAL STRUCTURE OF 3-5/METAL AND Si/METAL INTERFACES Annual Summary Report
L. J. Brillson 1 Oct. 1987 236 p
(Contract N00014-80-C-0778)
(AD-A186579) Avail: NTIS HC A11/MF A01 CSCL 07B

Over the past year, we have carried out an experimental program to investigate the electronic states and band structure at GaAs, InP, InxGa1-xAs, GaP, and Si/metal interfaces and their relationship to the chemical reactions and interdiffusion which evolve at room temperature and elevated temperatures. We have used soft X-ray photoemission spectroscopy to determine Fermi level movements and atomic redistribution during initial states of Schottky barrier formation and conventional electrical techniques to characterize transport mechanisms across these junctions. We have used cathodoluminescence spectroscopy to observe optical emission from interfaces states and their evolution with metal coverages. This annual report for the period October 1, 1986 through September 30, 1987 defines (Sec. II) and summarizes (Sec. III) the bulk of this research and includes the papers published or in press as a result of this effort. GRA

N88-17519# State Univ. of New York, Binghamton. Dept. of Chemistry.
COHESIVE ENERGIES OF TRANSITION METAL SILICIDES AND PHOSPHIDES Final Technical Report, 2 Jul. 1982 - 30 Jun. 1987
Clifford E. Myers 30 Sep. 1987 50 p
(Contract N00014-82-K-0501)
(AD-A186691) Avail: NTIS HC A03/MF A01 CSCL 07B

Vaporization studies have been carried out by mass loss Knudsen effusion on the Ni-P and chromium-phosphorus systems and by Knudsen effusion mass spectrometry on the V-Si, Cr-Si and Ti-Si systems. The experimental data were used to calculate enthalpies of formation of the intermediate phases in these systems. The stabilities of the 1:1 compounds, expressed as enthalpies of atomization, have been compared with each other and with data on silicides, phosphides, and sulfides from the literature to assess factors for inclusion in a phenomenological model for stability. These factors include: (1) the number and type of bonding electrons; (2) effective nuclear charges; (3) valence state energies; (4) the degree of partial electron transfer with a resulting Made lung energy; and (5) contributions from Lewis acid-base interactions involving back-donation of electrons. GRA

N88-17520# Israel Atomic Energy Commission, Yavneh. Nuclear Research Centre.
GROWTH OF HgZnTe LAYERS BY LPE TECHNIQUE Report, 1 Feb. - 1 Aug. 1987
Ariel Sher 1 Aug. 1987 3 p
(Contract DAJA45-85-C-0049)
(AD-A186723; SSP-PR-40-253-87; IAEC-R-4) Avail: NTIS HC A02/MF A01 CSCL 20B

The goal of this project is to evaluate the liquid phase epitaxy (LPE) growth technique as a tool for preparing Hg1-xZnxTe suitable for photodetectors. In the first year of this project optimization of the growth conditions was done. The objective for the second year is to study the parameters which determine the transport electrical properties of the Hg1-xZnTe epilayers. In this interim report we report the first results of annealing experiments on the epilayers and compare the characteristics of the annealed epilayers with those of the as grown. The as grown epilayers of Hg1-xZnxTe, 0.15 less than or equal to x less than or equal to 0.24 exhibit p type conductivity with carrier concentration of the order 1x10 to the 17th power/cm3. In order to decrease the carrier concentration down to the level of 1x10 to the 16th power, the optimum carrier concentration for photodetectors, the epilayers were annealed in Hg atmosphere. The conditions of the annealing were similar to those which are generally used for the annealing of Hg1-xCdxTe, namely, temperature of the sample around 400 C for several hours. tellurides. GRA

N88-17521# Connecticut Univ., Storrs. Inst. of Materials Science.
X-RAY DIFFRACTION STUDY OF THERMOTROPIC LIQUID CRYSTALLINE POLYESTERS AND DIESTER MODEL COMPOUNDS Interim Technical Report, 28 Aug. - 1 Oct. 1987
H. H. Chin, L. V. Azaroff, and A. C. Griffin 1 Oct. 1987 14 p
(Contract N00014-86-K-0772)
(AD-A186788; TR-5) Avail: NTIS HC A03/MF A01 CSCL 07C

Two nematic liquid crystalline polyesters were examined by X-ray diffraction following quenching from the nematic temperature in a magnetic field of 15 tesla. It was not possible to quench an aligned nematic glass; instead a polycrystalline phase showing some preferred orientation or an unoriented nematic melt yielded monodomain nematic diffraction patterns with one resembling that of a fiber (crystalline) photograph while the other showed good nematic alignment which could be enhanced slightly by annealing. A series of Siamese-twin diester model compounds also examined at their respective nematic temperatures in a magnetic field of compounds also were examined at their crystalline phase at room temperature. All displayed well-aligned nematic monodomains above the crystallization point. GRA

N88-17522# Arizona State Univ., Tempe. Coll. of Engineering and Applied Sciences.
MOLECULAR BEAM EPITAXY FOR RESEARCH ON QUANTUM WELL STRUCTURES Final Technical Report
George N. Maracas 15 Sep. 1987 18 p
(Grant AF-AFOSR-0222-86)
(AD-A186791; AFOSR-87-1516TR) Avail: NTIS HC A03/MF A01 CSCL 14B

Proposed was the purchase of a Molecular Beam Epitaxy (MBE) system as the key instrument to establish a coherent, interdisciplinary research program in the area of quantum well structure research. The system will have two growth chambers instead of the proposed single chamber. One is a conventional solid source MBE systm and the other is the novel gas source MBE with organometallic sources. Our growth capability is thus enhanced by the acquisition of a system in which pioneering materials research can be performed. Custom modifications to the growth systems have been incorporated to allow non-standard, in situe MBE analytical studies to be performed. It is believed that our MBE system is at present unique in a US university. These programs will concentrate on basic material growth kinetics in gas source MBE, heterojunction and multi-quantum well (MQW) electronic and optical properties and devices for integrated optoelectronics. GRA

N88-17523# Technische Hogeschool, Delft (Netherlands).
VERTICAL CHARGE TRANSPORT IN JUNCTION CHARGE-COUPLED DEVICES Ph.D. Thesis
Cornelis Leonardus M vanderKlauw 1987 179 p
(ETN-88-91613) Avail: NTIS HC A09/MF A01

Vertical charge transport in junction charge coupled devices (JCCD's) and its application in logic circuits were analyzed. Charge can be vertically injected into the JCCD transport channel through the steering gates by applying a vertical NPN transistor (injector), which can be made without any additional fabrication processing steps. The substrate PNP transistor, formed by the steering gate, the transport channel, and the substrate, can be used for the detection of surplus charge. The substrate PNP transistor was applied in a very simple, amplifying JCCD output structure, having a gain more than 100 while harmonic distortion is less than - 50 dB. Circuits based on vertical charge injection and vertical charge overflow of surplus charge were realized. And-or-invert circuits were operated at more than 50 MHz. A Full Adder was operated at 5 MHz. Performance can be improved by a fast charge-normalizing stage and a thinner epilayer. ESA

N88-17524# Technische Hochschule, Darmstadt (West Germany). Fachbereich Physik.
MAGNETIC PROPERTIES OF HEAVY FERMION SUPERCONDUCTORS Ph.D. Thesis [MAGNETISCHE EIGENSCHAFTEN VON SCHWERE-FERMIONEN SUPRALEITERN]
Ulrich Rauchschwalbe 1986 198 p In GERMAN
(ETN-88-91078) Avail: NTIS HC A09/MF A01

The magnetic properties of heavy fermion superconductors CeCu2Si2 as well as of the nonsuperconducting heavy-fermion substance CeAl3 between 0.02 and 4.2K were investigated. Measurements of magnetoresistivity and critical magnetic field reveal a number of exotic phenomena which are unknown for ordinary superconductors. An interpretation of these observed anomalies is presented. The analysis of the critical magnetic fields reveals the nature of superconducting phases of all the investigated heavy-fermion superconductors. It is shown that at the critical temperature Cooper pairs are only formed on parts of the Fermi surfaces. The magnetic properties vary strongly with small changes in the stoichiometry. From the Sommerfeld ratio it is explained why CeCu2Si2 is superconducting, and CeAl3 not. ESA

N88-17525# Technische Hochschule, Darmstadt (West Germany). Fachbereich Physik.
HEAVY FERMIONS AND COHERENCE IN KONDO LATTICES: SPECIFIC HEAT OF LOW ENERGY EXCITATION IN Cer SYSTEMS Ph.D. Thesis [SCHWERE FERMIONEN UND KOHAERENZ IN KONDO-GITTERN SPEZIFISCHE WAERME NIEDERENERGETISCHER ANREGUNGEN IN CER-SYSTEMEN]
Claus-Dieter Bredl 1985 124 p In GERMAN
(ETN-88-91080) Avail: NTIS HC A06/MF A01

The Kondo effect in Cer compounds and related concentrated Cer alloys was investigated at temperatures between 0.03 and 1 K in the nonmagnetically ordered lattices CeAl3 and CeCuSi2 as well as in the magnetically ordered lattices CeAl2, CeB6 and Cecu2, with emphasis on the highly correlated many-particle ground states and their excitations. The temperature dependence of the specific heat is well described assuming independent heavy fermionic quasi particles. The heavy fermions in CeAl3 and CeCu2Si2 show a local minimum in their state density, due to coherence on the Cer lattice, which manifests itself as a maximum in the specific heat. In the magnetically ordered Kondo lattices no significantly extended internal magnetic fields are found, and external fields decrease moderately. ESA

N88-17526# Technische Hochschule, Darmstadt (West Germany). Fachbereich Physik.
ELECTRON SPIN RESONANCE (ESR) MEASUREMENTS ON INTERMEDIATE-VALENCE CeR COMPOUNDS DOPED WITH PARAMAGNETIC IONS: CeOs2:Gd ION AND CePd3:Mn-ION Ph.D. Thesis [ELEKTRONENSPINRESONANZ-MESSUNGEN AN ZWISCHENVALENTEN CER-VERBINDUNGEN DOTIERT MIT PARAMAGNETISCHEN IONEN: CEOS2:GD3+ UND CEPD3:MN2+]
Helmut Schaeffer 1986 127 p In GERMAN
(ETN-88-91081) Avail: NTIS HC A07/MF A01

The electronic structure of intermediate-valence compounds was studied by Gd3+k electron spin resonance (ESR) measurements on CeOs2 and Mn2(+) ESR measurements on Celd3. The contribution of the Ce-4f stake density to the Korringa relaxation of the Gd-4f electrons in Celd3 and CeOs2 is found to be negligible. An Mn-ESR spectrum with resolved Mn hyperfine structure is observed for the first time in a metal. It is shown that the Anderson model for intermediate-valence compounds and the deduced model for the state densities of conduction and 4 f electrons can be described by the observed nonlinear temperature dependencies of line widths. The intermediate-valence state of the Ce-ions prevents the occurrence of an ESR-bottleneck. ESA

N88-17527# Technische Hochschule, Darmstadt (West Germany). Fachbereich Physik.
ELECTRONIC STRUCTURE CALCULATIONS AND BINDING ANALYSES FOR SELECTED BINARY AND TERNARY METAL HYDRIDES Ph.D. Thesis [ELEKTRONISCHE STRUKTUR-BERECHNUNGEN UND BINDUNGSANALYSEN FUER AUSGEWAEHLTE BINAERE UND TERNAERE METALLHYDRIDE]
Sven Cabus Sep. 1986 133 p In GERMAN
(ETN-88-91087) Avail: NTIS HC A07/MF A01

The electronic structure of metal hydrides was investigated to study behavior of hydrogen in metals and intermetallic compounds. The calculation of the electronic valence density, crystal symmetry and charge density, relativistic effects, and global energies are presented. Binary hybrids of the Vb-metals (V, Nb, Ta), and hybrid formation in FcTi are treated. The structure, ground state characteristics, and band structure data of hybrides of LaMi5 and homologous compounds are discussed. ESA

N88-17528# Technische Hochschule, Darmstadt (West Germany). Fachbereich Physik.
ANALYSIS OF THE VOLTAGE-CURRENT CHARACTERISTICS OF METAL-ISOLATOR-TIN-TELLURIDE SANDWICH STRUCTURES Ph.D. Thesis [ANALYSE DER STROM-SPANNUNGS-KENNLINIEN VON METALL-ISOLATOR-ZINNTELLURID
Rolf Enders 1986 201 p In GERMAN
(ETN-88-91089) Avail: NTIS HC A10/MF A01

Metal-aluminum oxide-SnTe sandwich structures were produced by molecular beam epitaxy and optimized using electron-optics investigations. Macro- and micro-structures, especially in the first and second derivatives of the voltage-current characteristics, were measured using high resolution tunnel spectroscopy. In tunnel diodes, with a thermally grown Al2O3 isolator layer, a large number of structures was observed which have their origin very probably in the critical point of the SnTe energy band structure. Theoretical band structure calculations show good or satisfactory agreement. The position of the Fermi energy with respect to the critical point is almost independent of the nominal hole concentration; possible theoretical explanations are discussed. ESA

N88-17529# Research Inst. of National Defence, Linkoeping (Sweden).
AN INVESTIGATION OF THE EQUIVALENT CIRCUIT AND CARRIER LIFETIMES OF Si/SiGe HETEROSTRUCTURE p-n DIODES FOR FREQUENCIES BETWEEN 0.5 AND 18.5 MHz
Lars Ahlfors, Staffan Rudner, and Magnus Willander (Linkoeping Univ., Sweden) Sep. 1987 38 p
(FOA-C-30469-3.2; ISSN-0347-3708; ETN-88-91675) Avail: NTIS HC A03/MF A01; Research Institute of National Defence, Stockholm, Sweden KR 50

An SixGe1-x/Si junction, doped as a p-n junction, was investigated. A method for measuring the lifetime of minority carriers in such structures was developed. The method utilizes an automatic network analyser with computer modeling. It was possible to determine the lower limit of the lifetime for holes in a thin layer of Si0.9Ge0.1 to 0.80 +/- 0.53 microsec. ESA

N88-17530# Massachusetts Inst. of Tech., Cambridge.
SOME PRESENT LIMITATIONS ON THE LATTICE IMAGING OF GRAIN BOUNDARIES
W. Mader, G. Necker, and R. W. Balluffi Sep. 1987 7 p
(Contract DE-FG02-87ER-45310)
(DE87-014665; DOE/ER-45310/5) Avail: NTIS HC A02/MF A01

Limitations which currently exist on using the electron microscope lattice imaging technique to obtain information about grain boundary structure are considered. Boundaries are only amenable when the adjoining crystals are oriented so that they produce projected patterns of resolved atomic columns or atomic planes. The conditions under which information can then be obtained about the atomistic core structure, the boundary translational state and the presence of localized grain boundary dislocations are described. In a number of instances, ultra-thin bicrystals are required which are probably too thin to be prepared and utilized on a practical basis. DOE

N88-17531# Argonne National Lab., Ill.
EPITAXIAL GROWTH AND NEW PHASE OF SINGLE CRYSTAL Dy BY MOLECULAR BEAM EPITAXY
Kai-Yueh Yang, Hitoshi Homma, and I. K. Schuller Sep. 1987 10 p Presented at the 32nd Conference on Magnetism and Magnetic Materials, Chicago, Ill., 9 Nov. 1987
(Contract W-31-109-eng-38)
(DE88-002850; CONF-871126-8) Avail: NTIS HC A02/MF A01

We have grown two novel epitaxial phases of dysprosium (Dy) on vanadium (V) by molecular beam epitaxy technique. Surface and bulk structures are studied by in-situ reflection high energy electron diffraction (RHEED) and X-ray diffraction techniques. The new hexagonal close packed (HCP) structure phases are approx. 4 percent expanded uniformly in-plane (0001), and approx. 9 percent and approx. 4 percent expanded out of plane along the c-axes for non-interrupted and interrupted deposition case, respectively. We also observed (2 x 2), (3 x 3), and (4 x 4) Dy surface reconstruction patterns and a series of transitions as the Dy film thickness increases. DOE

N88-17532# Argonne National Lab., Ill.
FREE ENERGY CALCULATION VIA MD (MOLECULAR DYNAMICS): METHODOLOGY AND APPLICATION TO BICRYSTALS
J. F. Lutsko, D. Wolf, and S. Yip Jul. 1987 6 p Presented at the Conference on Interface Science and Engineering, Lake Placid, N.Y., 12 Jul. 1987
(Contract W-31-109-eng-38)
(DE88-002902; CONF-870793-2) Avail: NTIS HC A02/MF A01

Three independent methods for the calculation of free energies via molecular dynamics are used to determine the free energies of crystalline solids. The relative accuracy and computational efficiency of the methods is compared and discussed. The free energies of two Cu bicrystals are then computed and compared over a wide range of temperatures and their relative stabilities are discussed. DOE

N88-17533# Argonne National Lab., Ill.
NATURE OF GIGANTIC RESISTANCE FLUCTUATIONS IN METAL-OXIDE-SEMICONDUCTOR WIRES
R. K. Kalia Jul. 1987 4 p Presented at the 11th International Workshop on Condensed Matter Theories, Oulu, Finland, 27 Jul. 1987
(Contract W-31-109-eng-38)

(DE88-002905; CONF-8707110-2) Avail: NTIS HC A02/MF A01

Recent advances in microfabrication have made it possible to create narrow electron channels in metal-oxide-semiconductor field-effect transistors (MOSFET). Using shadowing techniques, one can create gates 10 to 20 nm wide or, alternatively, one can use an electric field to pinch 2D electron gas in an accumulation layer. Resistivity measurements in these MOSFETs reveal a totally reproducible noise-like structure with varying gate voltage. The magnitude of these fluctuations grows considerably as the temperature is lowered and the temperature dependence of the resistivity is observed to be exp(A(T sub 0 T) sup 1/2). We summarize the experimental observations and the current theoretical understanding of resistance fluctuations in one-dimensional metal-oxide-semiconductor field-effect transistors. DOE

N88-17534# Argonne National Lab., Ill.
STRUCTURAL RELATIONSHIPS IN HIGH TEMPERATURE SUPERCONDUCTORS
I. K. Schuller, C. U. Segre, D. G. Hinks, J. D. Jorgensen, L. Soderholm, M. Beno, and K. Zhang Sep. 1987 9 p Presented at the Adriatico Conference on High Temperature Superconductors, Trieste, Italy, 6 Jul. 1987
(Contract W-31-109-eng-38)
(DE88-002924; CONF-8707109-2) Avail: NTIS HC A02/MF A01

The recent discovery of two types of metallic copper oxide compounds which are superconducting to above 90 K has renewed interest in the search for new high temperature superconducting materials. It is significant that both classes of compounds, La sub 2-x Sr sub x CuO sub 4-y and YBa2Cu3O sub 7-delta are intimately related to the extensively studied perovskite family. Both compounds contain highly oxidized, covalently bonded Cu-O sublattices, however, they differ in geometry. In this paper we discuss the relationship of these features to the superconducting properties. DOE

N88-17535# Argonne National Lab., Ill.
CHARACTERISTICS OF MULTIMUON EVENTS FROM FOURTH GENERATION QUARKS AT THE SSC (SUPERCONDUCTING SUPER COLLIDER)
Howard Baer 14 Aug. 1987 7 p Presented at the Workshop on Experiments, Detectors, and Experimental Areas for the Supercollider, Berkeley, Calif., 7 Jul. 1987
(Contract W-31-109-eng-38)
(DE88-002954; ANL-HEP-CP-87-87; CONF-870739-7) Avail: NTIS HC A02/MF A01

Multimuon events can be a distinctive signature for pair production of t-quarks or 4th generation quarks at the SSC. In this paper we address aspects of the multimuon event topology relevant to detector design for the SSC. In particular, we discuss energy measurement, rapidity range, segmentation and the need for hadronic calorimetry in a dedicated muon detector. DOE

N88-17536# Argonne National Lab., Ill.
HIGH-TEMPERATURE CHARGE-DENSITY STUDIES OF CeO/SUB 2-x/ USING X-RAY AND NEUTRON DIFFRACTION TECHNIQUES
J. Faber, Jr. Jul. 1987 22 p Presented at the International Conference on Electronic Structure in Phase Stability in Advanced Ceramics, Argonne, Ill., 17 Aug. 1987
(Contract W-31-109-eng-38)
(DE88-002988; CONF-870843-4) Avail: NTIS HC A03/MF A01

High-resolution Bragg scattering experiments have been used to study the structure of polycrystalline CeO sub 2-x. The in-situ experiments were carried out as a function of temperature (300 less than T less than 1500°K). The composition was controlled by flowing gases (CO/CO sub 2 or Ar/O sub 2 mixtures) over the sample. Results of both X-ray and neutron scattering experiments are used to define the principle atomic defects responsible for nonstoichiometry in CeO sub 2-x. Large lattice relaxation effects are observed whose magnitudes increase with increasing defect concentration. Temperature-dependent studies of the stoichiometric state (x = 0), show that lattice anharmonic interactions are important. The symmetry of the lattice anharmonic interactions is the same as the static displacements observed in the nonstoichiometric state. Thus, we propose that lattice anharmonic interactions are the fundamental driving force for the complex strain interactions observed in the nonstoichiometric state. DOE

N88-17537# Sandia National Labs., Albuquerque, N. Mex.
CONTROL OF SOLID-EXCITATION-BASED PHOTOCHEMICAL DRY ETCHING OF SEMICONDUCTORS BY ION-BOMBARDMENT-INDUCED DAMAGE
C. I. H. Ashby and D. R. Myers 1987 6 p Presented at the Fall Meeting of the Materials Research Society, Boston, Mass., 30 Nov. 1987
(Contract DE-AC04-76DP-00789)
(DE88-003214; SAND-87-1489C; CONF-871124-12) Avail: NTIS HC A02/MF A01

Carrier-driven photochemical dry etching of semiconductors can be selectively suppressed by ion-implantation-induced defects. The magnitude of this suppression depends on the semiconductor impurity doping concentration, the ion fluence, and the photo-excitation wavelength. DOE

N88-17538# Argonne National Lab., Ill. Fusion Power Program.
APPLICATION OF HIGH TEMPERATURE CERAMIC SUPERCONDUCTORS (CSC) TO COMMERCIAL TOKAMAK REACTORS
D. A. Ehst, S. Kim, Y. Gohar, L. Turner, D. L. Smith, and R. Mattas Oct. 1987 27 p
(Contract W-31-109-eng-38)
(DE88-003973; ANL/FPP/TM-214) Avail: NTIS HC A03/MF A01

Ceramic superconductors operating near liquid nitrogen temperature may experience higher heating rates without losing stability, compared to conventional superconductors. This will permit cable design with less stabilizer, reducing fabrication costs for large fusion magnets. Magnet performance is studied for different operating current densities in the superconductor, and cost benefits to commercial tokamak reactors are estimated. It appears that 10 kA . cm (-2) (at 77 K and approx. 10 T) is a target current density which must be achieved in order for the ceramic superconductors to compete with conventional materials. At current densities around 50 kA . cm (-2) most potential benefits have already been gained, as magnet structural steel begins to dominate the cost at this point. For a steady state reactor reductions of approx. 7 percent are forecast for the overall capital cost of the power plant in the best case. An additional approx. 3 percent cost saving is possible for pulsed tokamaks. DOE

N88-17539# Argonne National Lab., Ill.
NONEQUILIBRIUM SUPERCONDUCTIVITY FOR PARTICLE DETECTORS
K. E. Gray Oct. 1987 17 p Presented at the International Workshop on Superconductive Particle Detectors, Torino, Italy, 26 Oct. 1987
(Contract W-31-109-eng-38)
(DE88-002876; CONF-8710218-2) Avail: NTIS HC A03

A considerable amount of attention has been devoted to nonequilibrium superconductivity over the last 10 to 15 years. A fairly complete and quantatitive understanding of the experimental and theoretical aspects of the subject has emerged. In this paper aspects of nonequilibrium superconductivity which are relevant to a majority of particle detector applications will be reviewed, and new calculations, more specific to actual detector applications, will be presented. The primary focus is on ionizing particles for which the characteristic energy is greater than typical superconducting energy gap values of about 1 MeV. Thus microwave and far-infrared detection is excluded, although many of the results and consequences may also apply in those cases. DOE

N88-17540# Argonne National Lab., Ill.
SUPERCONDUCTIVITY IN La/SUB 1.85-x/Nd/SUB x/Sr/SUB .15/CuO
W. K. Kwok, G. W. Crabtree, A. Umezawa, L. Morss, and L. Soderholm May 1987 3 p Presented at the 18th Conference on Low Temperature Physics, Kyoto, Japan, 20 Aug. 1987
(Contract W-31-109-eng-38)
(DE88-003014; CONF-870873-24) Avail: NTIS HC A02

The effect of magnetic impurities on the high T/sub c/ superconductor La/sub 1.85/Sr/sub .15/CuO2 was investigated by replacing La with Nd. We find a depression of T/sub c/ and dH/sub c2/dT with increasing Nd concentration which does not follow predictions of the pairbreaking effects due to magnetic impurities. We attribute our experimental results to a density of states effect. DOE

N88-17541# Argonne National Lab., Ill.
HIGH TEMPERATURE SUPERCONDUCTIVITY RESEARCH AT ARGONNE NATIONAL LABORATORY
F. Y. Fradin Jul. 1987 19 p Presented at the 18th Conference on Superconductivity in Highly Correlated Fermion Systems, Sendai, Japan, 31 Aug. 1987
(Contract W-31-109-eng-38)
(DE88-003055; CONF-870881-5) Avail: NTIS HC A03/MF A01

Results are presented on the YBa2Cu3O sub 7-x phase, including the structure determination using neutron powder diffraction at IPNS, single-crystal measurements of magnetic anisotropy, and specific-heat measurements of the bulk superconducting transition. Theoretical and experimental considerations of the electronic anisotropies are discussed. DOE

N88-17542# Argonne National Lab., Ill.
COPPER OXIDATION STATES, VACANCY ORDERING AND THEIR EFFECT ON HIGH TEMPERATURE SUPERCONDUCTIVITY
I. K. Schuller, D. G. Hinks, J. D. Jorgensen, L. Soderholm, M. Beno, K. Zhang, C. U. Segre, Y. Bruynseraede, and J. P. Locquet Jul. 1987 7 p Presented at the NATO Advanced Study Institute on Physics, Fabrication, and Applications of Multilayered Structures, Ile de Bendor, France, 22 Jun. 1987 Prepared in cooperation with Illinois Inst. of Tech., Chicago and Louvain Univ., Belgium
(Contract W-31-109-eng-38)
(DE88-003079; CONF-8706237-1) Avail: NTIS HC A02/MF A01

We briefly review our comprehensive work on high temperature oxides which are isostructural with YBa2Cu3O(7-delta). X-ray and neutron diffraction, together with superconductive and normal state measurements show that the Cu-O chains present in the structure play an important role in the superconductivity. Whether the oxygen or the presence of copper in a 3(+) oxidation state is responsible for the high temperature superconductivity cannot be ascertained at the present time. DOE

N88-17543# Consiglio Nazionale delle Ricerche, Naples (Italy). Ist. di Cibernetica.
EFFECT OF THE SUBGAP CONDUCTANCE ON THE METASTABLE STATES IN A JOSEPHSON TUNNEL JUNCTION
R. Cristiano, S. Pagano, P. Silvestrini, K. E. Gray, and O. Liengme Sep. 1987 3 p Presented at the 18th Conference on Low Temperature Physics, Kyoto, Japan, 20 Aug. 1987 Prepared in cooperation with Argonne National Lab., Ill.
(Contract W-31-109-eng-38)
(DE88-003102; CONF-870873-23) Avail: NTIS HC A02

An investigation of the decay rate of metastable states in Josephson tunnel junctions in presence of thermal noise is presented. We have observed that, in the extremely underdamped regime, there is an exponential temperature dependence of the best fit value for the shunt conductance. Such a dependence shows a close relation with the temperature dependence of the subgap conductance, suggesting that the effective conductance for the escape from the metastable states obeys to a quasi-particle thermal activation mechanism. The introduction of this effective conductance into the lifetime expression for the zero-voltage states leads to significant changes in the width of the switching current distributions. A comparison of the experimental data with the proposed model is reported. DOE

N88-17544# Sandia National Labs., Albuquerque, N. Mex.
STABILITY AND METASTABILITY IN SEMICONDUCTOR STRAINED-LAYER STRUCTURES
B. W. Dodson, I. J. Fritz, S. T. Picraux, and J. Y. Tsao 1987 14 p Presented at the Fall Meeting of the Materials Research Society, Boston, Mass., 30 Nov. 1987
(Contract DE-AC04-76DP-00789)
(DE88-003308; SAND-87-1540C; CONF-871124-15) Avail: NTIS HC A03/MF A01

The physics governing stability properties and relaxation of mismatch strain in semiconductor strained-layer structures is reviewed. Experimental data on stablity and rates of strain relaxation are examined. We conclude that essentially all observations on structural relaxation of semiconductor strained-layer structures can be explained by standard models of plastic deformation adapted to the special conditions controlling dislocation dynamics in these structures. DOE

N88-17545# Oregon Univ., Eugene.
SURFACE AND INTERFACE ELECTRONIC STRUCTURE Progress Report No. 1
S. D. Kevan 1987 7 p
(Contract DE-FG06-86ER-45275)
(DE88-003363; DOE/ER-45275/1) Avail: NTIS HC A02/MF A01

This progress report discusses the work done at the Materials Science Institute in the following areas: anomalous surface state decay lengths and surface electronic structure of tungsten. DOE

N88-17546# Argonne National Lab., Ill.
MOLECULAR DYNAMICS STUDY OF HIGH-TEMPERATURE GRAIN-BOUNDARY STABILITY IN A (100) SIGMA = 29 BICRYSTAL MODEL
Tue Nguyen, Sidney Yip, and Dieter Wolf Aug. 1987 6 p Presented at the Conference on Interface Science and Engineering, Lake Placid, N.Y., 12 Jul. 1987
(Contract W-31-109-eng-38)
(DE88-002955; CONF-870793-4) Avail: NTIS HC A02/MF A01

A new molecular dynamics program for the investigation of planar bicrystalline interfaces at high temperature and finite external stress has been developed. The constant-stress (Parrinello-Rahman) method is combined with a Region 1-Region 2 treatment of the borders, thus avoiding (1) 3d-periodic border conditions (and therefore the presence of two interfaces in the computational unit cell) and (2) unphysical constraints arising from fixed borders. The usefulness of this new semi-periodic border treatment is illustrated in an investigation of the high-temperature stability and structure of the sigma = 29 (100) twist grain boundary. DOE

N88-17547*# Maryland Univ., College Park. Dept. of Chemistry and Biochemistry.
CRYSTALLINE SULFUR DIOXIDE: CRYSTAL FIELD SPLITTINGS, ABSOLUTE BAND INTENSITIES AND COMPLEX REFRACTIVE INDICES DERIVED FROM INFRARED SPECTRA
R. K. Khanna and Guizhi Zhao [1986] 21 p
(Grants NAGw-637; NAG5-216)
(NASA-CR-182502; NAS 1.26:182502) Avail: NTIS HC A03/MF A01 CSCL 20L

The infrared absorption spectra of thin crystalline films of sulfur dioxide at 90 K are reported in the 2700 to 450/cm region. The observed multiplicity of the spectral features in the regions of fundamentals is attributed to factor group splittings of the modes in a biaxial crystal lattice and the naturally present minor S-34, S-36, and O-18 isotopic species. Complex refractive indices determined by an iterative Kramers-Kronig analysis of the extinction data, and absolute band strengths derived from them, are also reported in this region. Author

N88-17423# Joint Publications Research Service, Arlington, Va.
PHENOMENOLOGICAL MODEL OF SUPERCONDUCTIVITY OF HEAVY FERMIONS IN U(SUB 1-x)ThSUBxBeSUB13 Abstract Only
V. V. Moshchalkov *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 27 Oct. 1987 p 42 Transl. into ENGLISH from Pisma v Zhurnal Eksperimentalnoy i Teoreticheskoy Fiziki (Moscow, USSR), v. 45, no. 4, 25 Feb. 1987 p 181-184 (For primary document see N88-17395 09-70)
Avail: NTIS HC A04/MF A01

N88-17424# Joint Publications Research Service, Arlington, Va.
PROPERTIES OF SUPERCONDUCTING TUNNEL STRUCTURES IN MICROWAVE RADIATION FIELD Abstract Only
F. I. Korzhinskiy, S. A. Koziychuk, A. N. Korolev, V. A. Obolonskiy, A. B. Orlenko, and A. S. Polishchuk *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 27 Oct. 1987 p 43 Transl. into ENGLISH from Zhurnal Tekhnicheskoy Fiziki (Leningrad, USSR), v. 57, no. 2, Feb. 1987 p 330-335 (For primary document see N88-17395 09-70)
Avail: NTIS HC A04/MF A01

N88-17425# Joint Publications Research Service, Arlington, Va.
MECHANISM OF CHANGE OF VORTEX STRUCTURE ORIENTATION IN TYPE-2 SUPERCONDUCTORS Abstract Only
V. M. Dzugutov *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 27 Oct. 1987 p 44-45 Transl. into ENGLISH from Fizika Tverdogo Tela (Leningrad, USSR), v. 29, no. 3, Mar. 1987 p 841-845 (For primary document see N88-17395 09-70)
Avail: NTIS HC A04/MF A01

N88-17426# Joint Publications Research Service, Arlington, Va.
SUPERCONDUCTIVITY AND CRYSTAL STRUCTURE OF HIGH-PRESSURE PHASES IN V-Ru-H SYSTEM Abstract Only
V. Ye. Animonov, I. T. Belash, Ye. G. Ponyatovskiy, V. I. Rashchupkin, and I. M. Romanenko *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 27 Oct. 1987 p 45-46 Transl. into ENGLISH from Fizika Tverdogo Tela (Leningrad, USSR), v. 29, no. 3, Mar. 1987 p 665-671 (For primary document see N88-17395 09-70)
Avail: NTIS HC A04/MF A01

77 THERMODYNAMICS AND STATISTICAL PHYSICS

Includes quantum mechanics; theoretical physics; and Bose and Fermi statistics.

For related information see also *25 Inorganic and Physical Chemistry* and *34 Fluid Mechanics and Heat Transfer.*

N88-17548# Johns Hopkins Univ., Baltimore, Md. Dept. of Physics and Astronomy.
RESEARCH IN THEORETICAL PHYSICS Annual Progress Report, 1 Apr. 1987 - 31 Mar. 1988
G. Domokos and S. Kovesi-Domokos Nov. 1987 15 p
(Contract DE-FG02-85ER-40211)
(DE88-003201; DOE/ER-40211/3) Avail: NTIS HC A03/MF A01

We report results in the following areas: phenomenological study of cosmic ray events with an anomalously large number of muons. We suggest that the anomalous events can be understood in terms of a substructure of quarks and leptons. We propose experiments to test this hypothesis and also to determine whether the primaries are photons or neutrinos, study of spontaneous compactification - technical progress has been made towards developing a stability analysis of partially compactified vacuum solutions in theories of gravity in higher dimensions, a preliminary study of algebras potentially describing quark and lepton substructure. The algebras are infinite dimensional, non-commutative Jordan algebras; they generalize ordinary Fermi and Bose algebras, and implementation of techniques of quantum field theory in the theory of turbulence. The statistical theory of fully developed turbulence is structurally similar to a Euclidean quantum field theory. By using modern techniques developed within the context of quantum field theory, a more efficient description of turbulence appears possible. DOE

N88-17549# Science Research Council, Chilton (England).
SOLID ANTIMATTER
M. M. Michaelis and R. Bingham Nov. 1986 22 p
(PB87-166146; RAL-86-091) Avail: NTIS HC E03/MF E03
CSCL 20C

The problems of creating solid antimatter are listed and examined. Laser driven accelerators may reduce the technological and financial magnitude of the task. Author

N88-17550# Science Research Council, Chilton (England).
AMBIGUITY IN DETERMINING THE EFFECTIVE ACTION FOR STRING-CORRECTED EINSTEIN GRAVITY
D. Hochberg and T. Shimada Nov. 1986 23 p Prepared in cooperation with Niels Bohr Inst., Copenhagen (Denmark)
(PB87-166153; RAL-86-097) Avail: NTIS HC E03/MF E03
CSCL 20C

The authors attempt to clarify some issues dealing with the determination of some of the coefficients appearing in the low-energy gravitational effective action for closed strings. In particular, they demonstrate with an explicit calculation that the coefficients of the (R sub mu,nu sup 2) and (R sup 2) terms of the quadratic curvature corrections to the Einstein-Hilbert action cannot be determined by matching the on-shell S-matrices of the effective theory with that of the string theories. The mechanism responsible for the ambiguity of these coefficients is revealed as a cancellation among the contact, exchange and point-insertion terms contributing to the tree S-matrix of the effective local theory. Although ghost poles will appear in the graviton propagator for general quadratic curvature corrections, the effective theory remains unitary. GRA

N88-17551# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
CORE SPLINE METHOD FOR SOLUTION OF QUANTUM-MECHANICAL SYSTEMS OF DIFFERENTIAL EQUATIONS FOR BOUND STATES
L. Aleksandrov, M. Drenska, and D. Karadzhov 1986 14 p
(DE88-700492; JINR-E-5-86-713) Avail: NTIS (US Sales Only) HC A03/MF A01

A generalization of the core spline method is given in the case of solution of the general bound state problem for a system of M linear differential equations with coefficients depending on the spectral parameter. The recursion scheme for construction of basic splines is described. The wave functions are expressed as linear combinations of basic splines, which are approximate partial solutions of the system. The spectral parameter (the eigenvalue) is determined from the condition for existence of a nontrivial solution of a (MxM) linear algebraic system at the last collocation point. The nontrivial solutions of this system determine (M - 1) coefficients of the linear spans, expressing the wave functions. The last unknown coefficient is determined from a boundary (or normalization) condition for the system. The computational aspects of the method are discussed, in particular, its concrete algorithmic realization used in the RODSOL program. The numerical solution of the Dirac system for the bound states of a hydrogen atom is given is an example. DOE

N88-17552# Tokyo Univ. (Japan). Inst. for Nuclear Study.
RENORMALIZATION GROUP ANALYSIS OF THE TEMPERATURE DEPENDENT COUPLING CONSTANT IN MASSLESS THEORY
Hirofumi Yamada Jun. 1987 15 p
(DE88-751059; INS-636) Avail: NTIS (US Sales Only) HC A03/MF A01

A general analysis of finite temperature renormalization group equations for massless theories is presented. It is found that in a direction where momenta and temperature are scaled up with their

ratio fixed the coupling constant behaves in the same manner as in zero temperature and that asymptotic freedom at short distances is also maintained at finite temperature. DOE

N88-17553# Lowell Univ., Mass.
CONSIDERATIONS OF ACCELERATION EFFECTS IN RELATIVISTIC KINEMATICS Ph.D. Thesis
Kenneth Edwin Caviness [1987] 147 p
Avail: Univ. Microfilms Order No. DA8721506

An extended special-relativistic formalism incorporating non-inertial frames undergoing constant proper acceleration is developed as a natural outgrowth of Einstein's 1905 and 1907 treatises. Based on the so-called clock hypothesis, tacitly used by Einstein, and enunciated by von Laue in 1913, which states that the rate of a ideal clock is independent of its momentary acceleration, extended special relativity (ESR) makes use of the Moeller transformation and generalizes the work of Brehme to form a consistent mathematical framework, revealing a number of hitherto hidden features. From this basis, a number of highly interesting kinematic phenomena are considered, among which are: the nonconstancy of the speed of light and the variation of time rates within an accelerated system; the Doppler shift and aberration of light in a noninertial system, viewed by an inertial observer; the curved path of a light signal, preparatory to a treatment of the spatial and temporal Terrell effects in the ESR formalism. The ensuing equations are compared with special relativistic results, and in each case the role of acceleration in the formulae is defined. Quantitative calculations were made, and the results shown in graph form. The ESR formalism is then shown to be a particular case of the general-relativistic formalism. The limits of the accelerated observer's universe and the limits of the theory are discussed. Dissert. Abstr.

N88-17430# Joint Publications Research Service, Arlington, Va.
CRITERION OF SINGULARITY IN GENERAL THEORY OF RELATIVITY Abstract Only
M. Ye. Gertsenshteyn and Ye. Yu. Melkumova *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 27 Oct. 1987 p 56 Transl. into ENGLISH from Izvestiya Vysshikh Uchebnykh Zavedeniy: Fizika (Tomsk, USSR), v. 30, no. 2, Feb. 1987 p 94-99 (For primary document see N88-17395 09-70)
Avail: NTIS HC A04/MF A01

N88-17431# Joint Publications Research Service, Arlington, Va.
RELATIVISTIC THEORY OF GRAVITATION AND NEW CONCEPTS ABOUT SPACE-TIME Abstract Only
A. A. Logunov *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 27 Oct. 1987 p 58 Transl. into ENGLISH from Teoreticheskaya i Matematicheskaya Fizika (Moscow, USSR), v. 70, no. 1, Jan. 1987 p 3-16 (For primary document see N88-17395 09-70)
Avail: NTIS HC A04/MF A01

80 SOCIAL SCIENCES (GENERAL)

Includes educational matters.

No abstracts in this category.

81 ADMINISTRATION AND MANAGEMENT

Includes management planning and research.

N88-17554# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Systems and Logistics.
AN EVALUATION OF PROJECT SCHEDULING TECHNIQUES IN A DYNAMIC ENVIRONMENT M.S. Thesis
James D. Martin Sep. 1987 160 p
(AD-A187057; AFIT/GSM/LSY/87-19) Avail: NTIS HC A08/MF A01 CSCL 05A

It is found, in general, that different project arrival distributions do affect the performance of scheduling heuristics and due date setting rules in an absolute sense, but not in a relative sense. Because of this, the project manager does not really need to be concerned about the arrival distribution of new projects. The best results are obtained when the Scheduled Finish project managers could implement this procedure due to the constraints, etc.. If they could use the SFT rule to set the due date of the arriving project, they would be wise to use the very simple First-In-First Served (FIFS) scheduling heuristic to allocate resources to the project. This research has determined that the relative performance of the tested scheduling heuristics and due date setting rules is unaffected by the project arrival distribution. GRA

N88-17555*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
POCC CAPABILITIES DOCUMENT. PAYLOAD SUPPORT CAPABILITIES DESCRIPTION: MCC, JSC POCC, REMOTE POCC INTERFACE
Ron J. Mayes Jun. 1987 469 p
(NASA-TM-89708; JSC-21063; NAS 1.15:89708) Avail: NTIS HC A20/MF A01 CSCL 05A

This document was written and structured to describe the standard capabilities and support services available to payload customers at the Mission Control Center (MCC), Johnson Space Center (JSC) Payloads Operations Control Center (POCC) and the remote POCC interface. Each standard capability and service is described to a level of detail that will allow the decision to be made as to whether or not the service is needed and if that service adequately meets the specific requirement. For each standard service or capability the data needed to configure the standard resources to meet the specific mission needs are described. Author

N88-16699*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
LEWIS MATERIALS RESEARCH AND TECHNOLOGY: AN OVERVIEW
Salvatore J. Grisaffe *In its* Aeropropulsion '87. Session 1: Aeropropulsion Materials Research Nov. 1987 8 p (For primary document see N88-16697 09-07)
Avail: NTIS HC A06/MF A01 CSCL 05A

N88-16731# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Data Handling and Signal Processing Div.
THE ESA CENTRALIZED MANAGEMENT SYSTEM FOR SATELLITE ELECTRONIC TEST AND CHECKOUT INSTRUMENTATION
J. B. Rowles *In its* ESA Bulletin No. 10 Aug. 1977 p 22-28 (For primary document see N88-16728 09-12)
Avail: NTIS HC A05/MF A01

N88-17226*# Battelle Columbus Labs., Ohio.
SYSTEMS INTEGRATED HUMAN ENGINEERING ON THE NAVY'S RAPID ACQUISITION OF MANUFACTURED PARTS/TEST AND INTEGRATION FACILITY
Glen R. Gallaway *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 147-152 (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 05A

N88-17249*# IBM Federal Systems Div., Gaithersburg, Md.
RANGE AND MISSION SCHEDULING AUTOMATION USING COMBINED AI AND OPERATIONS RESEARCH TECHNIQUES
Mansur Arbabi and Michael Pfeifer *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 315-320 (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 05A

82 DOCUMENTATION AND INFORMATION SCIENCE

Includes information management; information storage and retrieval technology; technical writing; graphic arts; and micrography.

For computer documentation see *61 Computer Programming and Software.*

N88-17556# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Systems and Logistics.
INFORMATION NEEDS ANALYSIS FOR THE AERONAUTICAL SYSTEMS DIVISION EXECUTIVE INFORMATION SYSTEM M.S. Thesis
Kenneth J. Lentini Sep. 1987 56 p
(AD-A186912; AFIT/GSM/LSMA/87S-42) Avail: NTIS HC A04/MF A01 CSCL 05B

The purpose of this study was to determine, using Ostrofsky's design and planning methodology, the adequacy of the information provided to the executive managers at ASD. To accomplish this objective, a sample of executive managers from ASD was interviewed to determine information needs against the information available. The results indicate that staff executives are receiving the information they need in the form which they prefer, while the line executives lack the automated data they need. Research also revealed that most ASD executives are not satisfied with the Automated Management System for many reasons such as lack of current data. The objective of this thesis was not to solve the information requirement problems of the ASD executives. Rather it was intended to be the first step in a series of research efforts leading to a solution to these problems. GRA

N88-17557# Northrop Corp., Anaheim, Calif. Electro-mechanical Div.
MANAGEMENT INFORMATION AND DOWNLOADER INTERFACE SYSTEM (MIDIS) Final Report, Aug. 1985 - Sep. 1987
Stan Wong 11 Jun. 1987 78 p
(Contract DAAL01-85-C-0404)
(AD-A186978; NORT-321953-1) Avail: NTIS HC A05/MF A01 CSCL 20F

The Management Information and Downloader Interface System (MIDIS) is a program to develop the foundation for an advanced sensor test facility for the U.S. Army Center for Night Vision and Electro-Optics (CNVEO). MIDIS will perform a variety of tasks related to the acquisition, manipulation, and animation of image data collected from a variety of sensors with differing formats and media. In addition, MIDIS will collect, manage, and make available ground truth information from high bit rate (HBR) digital tapes formatted to the Advanced Target Recognizer Working Group (ATRWG) specification of February 1985. The MIDIS functions are: (1) download to computer disk image data; (2) collect and catalog ground-truth data from tapes; (3) manipulate image data; (4) manage image data catalog (ground truth); and (5) upload images on computer disk. GRA

N88-17558# Naval Postgraduate School, Monterey, Calif.
APPLICATION OF A DATABASE SYSTEM FOR INVENTORY MANAGEMENT OF CLASSIFIED MATERIAL M.S. Thesis
Rolando M. Lim Sep. 1987 80 p
(AD-A186986) Avail: NTIS HC A05/MF A01 CSCL 05B

The purpose of this study was to develop a database system model suitable for implementation onboard Naval ships, and to aid in the inventory management of classified material in this environment. The developed system must be considered a prototype model which may need further modification and extension in order to fit a specific user's need. Although the system must be considered a prototype in its present form, the application program will perform all the basic jobs of the sub-custodian with regard to inventory management. Since dBase III PLUS was used in the application program of this thesis, a relational database must be used. A brief discussion of relational database model was reviewed in Chapter II, in order to give the user basic knowledge of the model. The system is menu driven, not only easy to use but also easy to develop a database modify, since both the user and the programmer are directed to the desired point through the sequence of menus and sub-menus. Finally, it is up to the security manager and secret custodian to monitor the effectiveness of this application program during the initial implementation stage and throughout its life cycle. GRA

N88-17559*# California Univ., Santa Barbara.
KBGIS-II: A KNOWLEDGE-BASED GEOGRAPHIC INFORMATION SYSTEM
Terence Smith, Donna Peuquet, Sudhakar Menon, and Pankaj Agarwal 15 May 1986 44 p
(Contract NCC2-359)
(NASA-CR-182492; NAS 1.26:182492) Avail: NTIS HC A03/MF A01 CSCL 05B

The architecture and working of a recently implemented Knowledge-Based Geographic Information System (KBGIS-II), designed to satisfy several general criteria for the GIS, is described. The system has four major functions including query-answering, learning and editing. The main query finds constrained locations for spatial objects that are describable in a predicate-calculus based spatial object language. The main search procedures include a family of constraint-satisfaction procedures that use a spatial object knowledge base to search efficiently for complex spatial objects in large, multilayered spatial data bases. These data bases are represented in quadtree form. The search strategy is designed to reduce the computational cost of search in the average case. The learning capabilities of the system include the addition of new locations of complex spatial objects to the knowledge base as queries are answered, and the ability to learn inductively definitions of new spatial objects from examples. The new definitions are added to the knowledge base by the system. The system is performing all its designated tasks successfully. Future reports will relate performance characteristics of the system.
Author

N88-17207*# Air Force Human Resources Lab., Wright-Patterson AFB, Ohio.
IMIS: INTEGRATED MAINTENANCE INFORMATION SYSTEM. A MAINTENANCE INFORMATION DELIVERY CONCEPT
Joseph C. VonHolle *In* NASA. Lyndon B. Johnson Space Center, Houston, Texas, First Annual Workshop on Space Operations Automation and Robotics (SOAR 87) Oct. 1987 p 1-9 (For primary document see N88-17206 09-59)
Avail: NTIS HC A23/MF A01 CSCL 05B

83 ECONOMICS AND COST ANALYSIS

Includes cost effectiveness studies.

No abstracts in this category.

84 LAW, POLITICAL SCIENCE AND SPACE POLICY

Includes NASA appropriation hearings; aviation law; space law and policy; international law; international cooperation; and patent policy.

N88-16724# European Space Agency, Paris (France). Dept. of International and Legal Affairs.
A POLICY FOR INTERNATIONAL RELATIONS
H. Kaltenecker *In its* ESA Bulletin No. 8 Feb. 1977 p 29-44
(For primary document see N88-16718 09-12)
Avail: NTIS HC A05/MF A01

N88-16768# European Space Agency, Paris (France).
ENTRY INTO FORCE OF THE ESA CONVENTION

M. Bourely *In its* ESA Bulletin No. 25 Feb. 1981 p 6-9 In ENGLISH and FRENCH (For primary document see N88-16767 09-12)
Avail: NTIS HC A05/MF A01

85 URBAN TECHNOLOGY AND TRANSPORTATION

Includes applications of space technology to urban problems; technology transfer; technology assessment; and surface and mass transportation.

For related information see also *03 Air Transportation and Safety, 16 Space Transportation,* and *44 Energy Production and Conversion.*

N88-17560# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Systems and Logistics.
A STUDY OF FEDERAL TECHNOLOGY TRANSFER TO THE COMMERCIAL SECTOR M.S. Thesis
Michael J. Olsen Sep. 1987 154 p
(AD-A187017; AFIT/GLM/LSP/87S-52) Avail: NTIS HC A08/MF A01 CSCL 05B

The Federal Technology Transfer Act of 1986 imposed legislative requirements on federal labs to take certain actions to facilitate the transfer of federally developed technology to the commercial sector. This study examined the requirements of the 1986 Act and had the following three specific objectives: (1) to examine opportunities and barriers, as perceived by federal laboratory personnel, to the commercial application of federally developed technology to the private sector, (2) to examine the perceptions of federal laboratory personnel regarding the 1986 Act, and (3) to use the information from the first two objectives to suggest ways to ease and enhance the ever challenging process of technology transfer. A survey of 479 federal lab personnel including both managers and scientists/engineers was conducted in support of the above objectives. Overall, the results of the study support the findings of previous research. Recommendations are offered to help make technology transfer and the implementation of the 1986 Act a success. GRA

N88-17561*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
OVERVIEW OF HEAT TRANSFER AND FLUID FLOW PROBLEM AREAS ENCOUNTERED IN STIRLING ENGINE MODELING
Roy C. Tew, Jr. Feb. 1988 23 p Presented at the 1987 Winter Annual meeting of the American Society of Mechanical Engineers, Boston,Massachusetts, 14-16 Dec. 1987
(NASA-TM-100131; E-3680; NAS 1.15:100131) Avail: NTIS HC A03/MF A01 CSCL 10B

NASA Lewis Research Center has been managing Stirling engine development programs for over a decade. In addition to contractual programs, this work has included in-house engine testing and development of engine computer models. Attempts to validate Stirling engine computer models with test data have demonstrated that engine thermodynamic losses need better characterization. Various Stirling engine thermodynamic losses and efforts that are underway to characterize these losses are discussed. Author

88 SPACE SCIENCES (GENERAL)

No abstracts in this category.

89 ASTRONOMY

Includes radio, gamma-ray, and infrared astronomy, and astrometry.

N88-17562# Officine Galileo S.p.A., Florence (Italy).
INTEGRATED FOCAL PLANE STAR SENSOR Final Report
G. Borghi, M. Carboncini, and M. Stagi Paris, France ESA Mar. 1987 213 p
(Contract ESTEC-6107/84-NL-PL)
(OG-RT/86-0156; ESA-CR(P)-2463; ETN-88-91417) Copyright Avail: NTIS HC A10/MF A01

A theoretical analysis on the detectors suitable for the Infrared Space Observer (ISO) Integrated Focal Plane Star Sensor (IFPSS) design are presented together with system configuration concepts. A simplified configuration with respect to the electronic design was analyzed in order to reduce the power consumption, the mass, and the overall complexity of the sensor. The breadboard design is described. The system can use two different types of detector by means of variations in the H/W: a position sensing light detector, and a quadrant detector. Both were assembled and tested at ambient and cryogenic temperature by the IFPSS test equipment. The quadrant detector is recommended. The preamplifier is based on uncapsulated, self-heating JFET structures. Working temperature is 20 K and accuracy is within 1 arcsec. ESA

N88-17563# Max-Planck-Inst. fuer Physik und Astrophysik, Garching (West Germany). Inst. fuer Extraterrestrische Physik.
RECENT X-RAY OBSERVATIONS OF SUPERNOVA REMNANTS AND THEIR INTERPRETATION
B. Aschenbach Aug. 1987 19 p Presented at the IAU Colloquium 101, Penticton, Canada, Jun. 1987
(MPE-Preprint-96; ETN-88-91459) Copyright Avail: NTIS HC A03/MF A01

Observations of the X-ray emission from supernova remnants carried out on the Einstein, Tenma, and EXOSAT satellites, and sounding rocket experiments are reviewed. Interpretation of the high resolution images, high resolution energy spectra, and spectrally resolved images is discussed. ESA

N88-17564 Toledo Univ., Ohio.
MAPPING STELLAR SURFACE FEATURES Ph.D. Thesis
Paul Vincent Noah 1987 140 p
Avail: Univ. Microfilms Order No. DA8722198

New photometric and spectroscopic observations of the RS Canum Venaticorum binaries Sigma Geminorum and UX Arietis are reported along with details of the Doppler imaging program SPOTPROF. The observations suggest that the starspot activity on Sigma Gem has decreased to 0.05 magnitude in two years. A photometric spot model for Sep. 1984 to Jan. 1985 found that a single spot covering 2 percent of the surface and 1000 K cooler than the surrounding photosphere could model the light variations. Equivalent width observations contemporaneous with the photometric observations did not show any significant variations. Line profile models from SPOTPROF predict that the variation of the equivalent width of the 6393 A Fe I line should be approx. 1 mA. Photometric observations of UX Ari from Jan. 1984 to Mar. 1985 show an 0.3 magnitude variation indicating a large spot group must cover the surface. Same-time spectroscopic observations show asymmetric line profiles. The Doppler imaging and the photometric light curve model were used in an iterative method to describe the stellar surface spot distribution and successfully model both the photometric and spectroscopic variations.
Dissert. Abstr.

N88-17565*# Smithsonian Astrophysical Observatory, Cambridge, Mass.
BALLOON-BORNE THREE-METER TELESCOPE FOR FAR-INFRARED AND SUBMILLIMETER ASTRONOMY Semiannual Status Report No. 6, 1 Mar. - 31 Aug. 1986
Giovanni G. Fazio Dec. 1986 53 p
(Grant NAGw-509)
(NASA-CR-182310; NAS 1.26:182310) Avail: NTIS HC A04/MF A01 CSCL 03A

The study and revision of the gimbal design of the Three-Meter Balloon Borne Telescope (TMBBT) is discussed. Efforts were made to eliminate the alignment and limited rotation problems inherent in the flex-pivot design. A new design using ball bearings to replace the flex-pivots was designed and its performance analyzed. An error analysis for the entire gondola pointing system was also prepared. Author

N88-16721# European Space Agency, Paris (France). Dept. of Future Scientific Programs.
THE 2.4 m SPACE TELESCOPE AND ESA PARTICIPATION IN THE PROGRAM
V. Manno *In its* ESA Bulletin No. 8 Feb. 1977 p 13-17 (For primary document see N88-16718 09-12)
Avail: NTIS HC A05/MF A01

N88-16722# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Space Science Dept.
INFRARED ASTRONOMY: WHY AND HOW?
J. E. Beckmann *In its* ESA Bulletin No. 8 Feb. 1977 p 18-23 (For primary document see N88-16718 09-12)
Avail: NTIS HC A05/MF A01

N88-16782# European Space Agency, Paris (France). Scientific Program Directorate.
USE OF SPACE STATION FOR SPACE SCIENCE
G. P. Haskell *In its* Proceedings of the ESA Workshop on Co-Orbiting Platform Elements (COPE) Sep. 1987 p 25-26 (For primary document see N88-16777 09-12)
Copyright Avail: NTIS HC A04/MF A01

90 ASTROPHYSICS

Includes cosmology; celestial mechanics; space plasmas; and interstellar and interplanetary gases and dust.
For related information see also *75 Plasma Physics.*

N88-17566# Los Alamos National Lab., N. Mex.
TRANSVERSE FLOW DEFLECTIONS ASSOCIATED WITH FAST CORONAL MASS EJECTA IN INTERPLANETARY SPACE
J. T. Gosling, M. F. Thomsen, S. J. Bame, and R. D. Zwickl 1987 6 p Presented at the 6th Meeting of Solar Wind, Estes Park, Colo., 24 Aug. 1987
(Contract W-7405-eng-36)
(DE88-003180; LA-UR-87-3688; CONF-8708141-5) Avail: NTIS HC A02/MF A01

Using a bidirectional electron heat flux signature to identify coronal mass ejections (CMEs) in the solar wind at 1 AU, it is found that the fast CMEs which drive interplanetary shocks are preferentially deflected eastward in transit outward from the Sun. A corresponding westward deflection usually occurs in the compressed ambient solar wind plasma ahead of these CMEs. It is suggested that this preferential pattern of deflections is caused primarily by the asymmetrical draping of the ambient interplanetary magnetic field about fast CMEs. DOE

91 LUNAR AND PLANETARY EXPLORATION

Includes planetology; and manned and unmanned flights.
For spacecraft design or space stations see *18 Spacecraft Design, Testing and Performance.*

N88-17567# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Systems and Logistics.
CRITICAL ISSUES FOR ESTABLISHMENT OF A PERMANENTLY-OCCUPIED LUNAR BASE M.S. Thesis
Paul C. Kent, II Sep. 1987 124 p
(AD-A187128; AFIT/GSM/LSPA/87S-13) Avail: NTIS HC A06/MF A01 CSCL 05A

The purpose of this study was to determine the critical issues for a potential lunar outpost by polling a group of experts knowledgeable about decision-making involving the allocation of large-scale resources. A Delphi exercise is an iterative polling technique in which the group opinion is refined during successive iterations, while at the same time preserving differing viewpoints. The experts identified four critical issues: (1) demonstration of the value of a lunar base (e.g., cost effective lunar-based science, source of raw materials, technology spin-offs, etc.); (2) sustained political and financial support; (3) credibility of the government (i.e., NASA) in accomplishing such a large and complex program; (4) development of the military value of a lunar base. GRA

N88-17568*# Georgia Inst. of Tech., Atlanta. School of Geophysical Sciences.
DEVELOPMENT OF AN ENGINEERING MODEL ATMOSPHERE FOR MARS Semiannual Status Report, 23 Sep. 1987 - 22 Mar. 1988
C. G. Justus Mar. 1988 29 p
(Grant NAG8-078)
(NASA-CR-182462; NAS 1.26:182462) Avail: NTIS HC A03/MF A01 CSCL 03B

An engineering model atmosphere for Mars is being developed with many of the same features and capabilities for the highly successful Global Reference Atmospheric Model (GRAM) program for Earth's atmosphere. As an initial approach, the model is being built around the Martian atmosphere model computer subroutine (ATMOS) of Culp and Stewart (1984). In a longer-term program of research, additional refinements and modifications will be included. ATMOS includes parameterizations to stimulate the effects of solar activity, seasonal variation, diurnal variation magnitude, dust storm effects, and effects due to the orbital position of Mars. One of the current shortcomings of ATMOS is the neglect of surface variation effects. The longer-term period of research and model building is to address some of these problem areas and provide further improvements in the model (including improved representation of near-surface variations, improved latitude-longitude gradient representation, effects of the large annual variation in surface pressure because of differential condensation/sublimation of the CO2 atmosphere in the polar caps, and effects of Martian atmospheric wave perturbations on the magnitude of the expected density perturbation. Author

92 SOLAR PHYSICS

Includes solar activity, solar flares, solar radiation and sunspots.
For related information see *93 Space Radiation.*

N88-17569# Bern Univ. (Switzerland). Div. of Solar Observations.
BERN SOLAR OBSERVATIONS. SOLAR DATA FOR JANUARY-DECEMBER 1986
1986 12 p
(Rept-53; ETN-88-91684) Avail: NTIS HC A03/MF A01

The results of the standard measurements carried out at the solar observatory are presented. The measurements show start, maximum, duration, peak, flux, and circular polarization at peak as percentage, of outstanding events. ESA

N88-17570# National Geophysical Data Center, Boulder, Colo.
SOLAR-GEOPHYSICAL DATA NUMBER 516, AUGUST 1987. PART 1: (PROMPT REPORTS). DATA FOR JULY 1987, JUNE 1987 AND LATE DATA
Helen E. Coffey, ed. and John A. McKinnon, ed. Aug. 1987 93 p
(PB88-114368; SGD-516-Pt-1; ISSN-0038-0911; LC-79-640375)
Avail: NTIS HC A05/MF A01 CSCL 03B

This report on solar geophysical data contains the following: Detailed index for 1986-1987; Data for July 1987 - (IUWDS alert periods (Advance and Worldwide), Solar activity indices, Solar flares, Solar radio emission, Stanford mean solar magnetic field);

Data for June 1987 - (Solar active regions, Sudden ionospheric disturbances, Solar radio spectral observations, Cosmic ray measurements by neutron monitor, Geomagnetic indices, Radio propagation indices): Late data - (Pioneer 12 interplanetary magnetic field magnitudes Nov. 86, Geomagnetic indices. GRA

N88-17571# National Geophysical Data Center, Boulder, Colo.
SOLAR-GEOPHYSICAL DATA NUMBER 516, AUGUST 1987. PART 2: (COMPREHENSIVE REPORTS). DATA FOR FEBRUARY 1987
Helen E. Coffey, ed. and John A. McKinnon, ed. Aug. 1987 59 p
(PB88-114376; SGD-516-Pt-2; ISSN-0038-0911; LC-79-640375)
Avail: NTIS HC A04/MF A01 CSCL 03B

This report on solar-geophysical data contains the following: a detailed index for 1986-1987; data for February 1987 (Meudon carte synoptique, Solar flares, Solar radio bursts at fixed frequencies, Solar X-ray radiation from GOES satellite, Active prominences and filaments); Miscellaneous data - Cosmic ray measurements by neutron monitor. GRA

N88-17572*# Iowa Univ., Iowa City. Dept. of Physics and Astronomy.
DATA REDUCTION AND ANALYSIS OF HELIOS PLASMA WAVE DATA Final Technical Report, 1 Jun. 1985 - 31 May 1987
Roger R. Anderson 4 Mar. 1988 7 p
(Grant NAG5-527)
(NASA-CR-182466; NAS 1.26:182466) Avail: NTIS HC A02/MF A01 CSCL 03B

Reduction of data acquired from the HELIOS Solar Wind Plasma Wave Experiments on HELIOS 1 and 2 was continued. Production of 24 hour survey plots of the HELIOS 1 plasma wave data were continued and microfilm copies were submitted to the National Space Science Data Center. Much of the effort involved the shock memory from both HELIOS 1 and 2. This data had to be deconvoluted and time ordered before it could be displayed and plotted in an organized form. The UNIVAX 418-III computer was replaced by a DEC VAX 11/780 computer. In order to continue the reduction and analysis of the data set, all data reduction and analysis computer programs had to be rewritten. B.G.

N88-17573# Los Alamos National Lab., N. Mex.
OSCILLATIONS OF SOLAR MODELS WITH INTERNAL ELEMENT DIFFUSION
A. N. Cox, J. A. Guzik, and R. B. Kidman 1987 6 p Presented at the Solar Radiative Output Variations, Boulder, Colorado, 9 Nov. 1987 Prepared in cooperation with Iowa State Univ. of Science and Technology, Ames
(Contract W-7405-eng-36)
(DE88-003156; LA-UR-87-3817; CONF-8711112-1) Avail: NTIS HC A02/MF A01

Two precision solar models were constructed with the Iben evolution program, one with no diffusion of the internal atomic nuclei, and another that includes the effects of gravitational settling, thermal diffusion, and concentration gradient diffusion on the element abundances. This paper reports the results of these models. DOE

93 SPACE RADIATION

Includes cosmic radiation; and inner and outer earth's radiation belts.

For biological effects of radiation see *52 Aerospace Medicine*. For theory see *73 Nuclear and High-Energy Physics*.

N88-17574# Pennsylvania Univ., Philadelphia. Dept. of Physics.
A COMBINED COSMIC RAY MUON SPECTROMETER AND HIGH ENERGY AIR SHOWER ARRAY
M. L. Cherry, D. S. Ayres, and F. Halzen 1986 5 p Presented at the Summer Study on the Physics of the Superconducting Super Collider, Snowmass, Colo., 23 Jun. 1986 Prepared in cooperation with Argonne National Lab., Ill. and Wisconsin Univ., Madison
(Contract W-31-109-eng-38)
(DE88-003057; ANL-HEP-CP-86-139; CONF-8606215-46) Avail: NTIS HC A02

Cosmic rays have been detected at energies in excess of 10 to the 20th eV, and individual sources have been conclusively identified as intense emitters of gamma rays at energies up to 10 to the 16th eV. There is clearly a great deal of exciting astrophysics to be learned from such studies, but it has been suggested that there may be particle physics to be learned from the cosmic beam as well. Based in particular on the reports of surprisingly high fluxes of underground muons from the direction of Cygnus X-3 modulated by the known orbital period, there have been several suggestions recently invoking stable supersymmetric particles produced at Cygnus X-3, enhanced muon production from high energy photons, quark matter, and cygnets. Although the underground muon results have been questioned, it may still be worthwhile to consider the possibility of new physics beyond the standard model with energy scale (G(sub F)/sup -1/2) greater than or equal to 0.25 TeV. For example, there have been recent discussions on the experimental signatures to be observed from new high energy photon couplings to matter, exchanges between constituent quarks and leptons, and stable gluinos and photinos mixed in with the cosmic gamma ray flux. Described here is a possible detector to search for such effects, utilizing the possibility that point sources like Cygnus X-3 can be used to provide a directional time-modulated tagged high energy photon beam. DOE

N88-17575# California Univ., Irvine. Dept. of Physics.
A RESEARCH PROGRAM IN NEUTRINO PHYSICS, COSMIC RAYS AND ELEMENTARY PARTICLES Progress Report, Jan. - Dec. 1987
F. Reines, H. H. Chen, P. J. Doe, W. Gajewski, A. A. Hahn, W. R. Kropp, M. K. Moe, R. D. Newman, L. Price, and H. W. Sobel Aug. 1987 34 p
(Contract DE-AT03-76ER-71019)
(DE88-003507; DOE/ER-71019/T1) Avail: NTIS HC A03/MF A01

This paper reports the observation of a two-neutrino double beta decay of selenium 82 in the laboratory. It also contains short summaries on the following work: neutrino electron elastic scattering, the large Cerenkov detector, the Cygnus experiment and the Sudbury Neutrino Observatory. DOE

N88-17576 California Univ., Los Angeles.
THE RADIO STRUCTURE OF ACTIVE NUCLEI IN EDGE-ON SPIRAL AND SEYFERT GALAXIES Ph.D. Thesis
Ann Elizabeth Wehrle 1987 197 p
Avail: Univ. Microfilms Order No. DA8723214

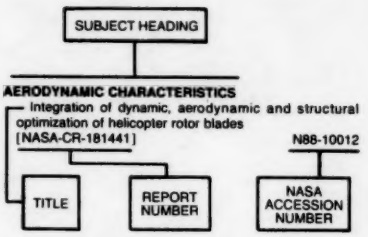
High resolution radio images of the nuclei of 35 nearly normal spiral and Seyfert galaxies were obtained with the Very Large Array in order to establish the dominant physical processes that cause radio emission within the inner kiloparsec region. The main conclusions reached are: (1) The nuclei of spiral galaxies are extremely weak in the radio. (2) Early- and late-type galaxies in the complete sample are equally likely to contain compact radio cores with flux densities greater than 0.6 mJy. (3) There is no correlation between the orientation of extended radio structure in the galactic nuclei and that of the galactic disks. (4) Several spiral and Seyfert galaxies display radio loops and collimated jet-like structures. (5) Radio loops in NGC 5506 and NGC 2992 may be interpreted as magnetically dominated structures, possibly similar in origin to the Arc in our own Galactic Center. (6) Interaction with a companion increases the likelihood of nuclear activity. (7) Two galaxies, NGC 55 and NGC 4631, show evidence of massive episodes of star formation. Dissert. Abstr.

99 GENERAL

N88-17577*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
RESEARCH AND TECHNOLOGY 1987 Annual Report
Dec. 1987 154 p
(NASA-TM-4021; L-16381; NAS 1.15:4021) Avail: NTIS HC A08/MF A01 CSCL 05D

The mission of the NASA Langley Research Center is to increase the knowledge and capability of the United States in a full range of aeronautics disciplines and in selected space disciplines. This mission will be accomplished by: performing innovative research relevant to national needs and Agency goals; transferring technology to users in a timely manner; and providing development support to other United States Government agencies, industry, and other NASA centers. Contained are highlights of the major accomplishments and applications that were made during the past year. The highlights illustrate both the broad range of the research and technology activities at the NASA Langley Research Center and the contributions of this work toward maintaining United States leadership in aeronautics and space research. Author

Typical Subject Index Listing



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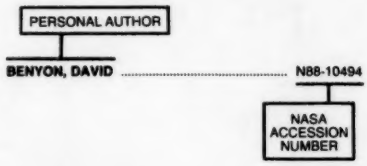

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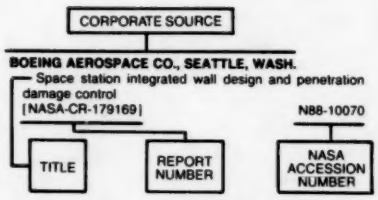

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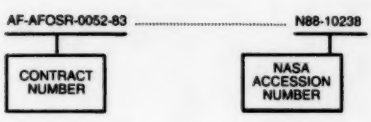

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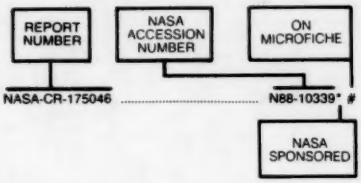

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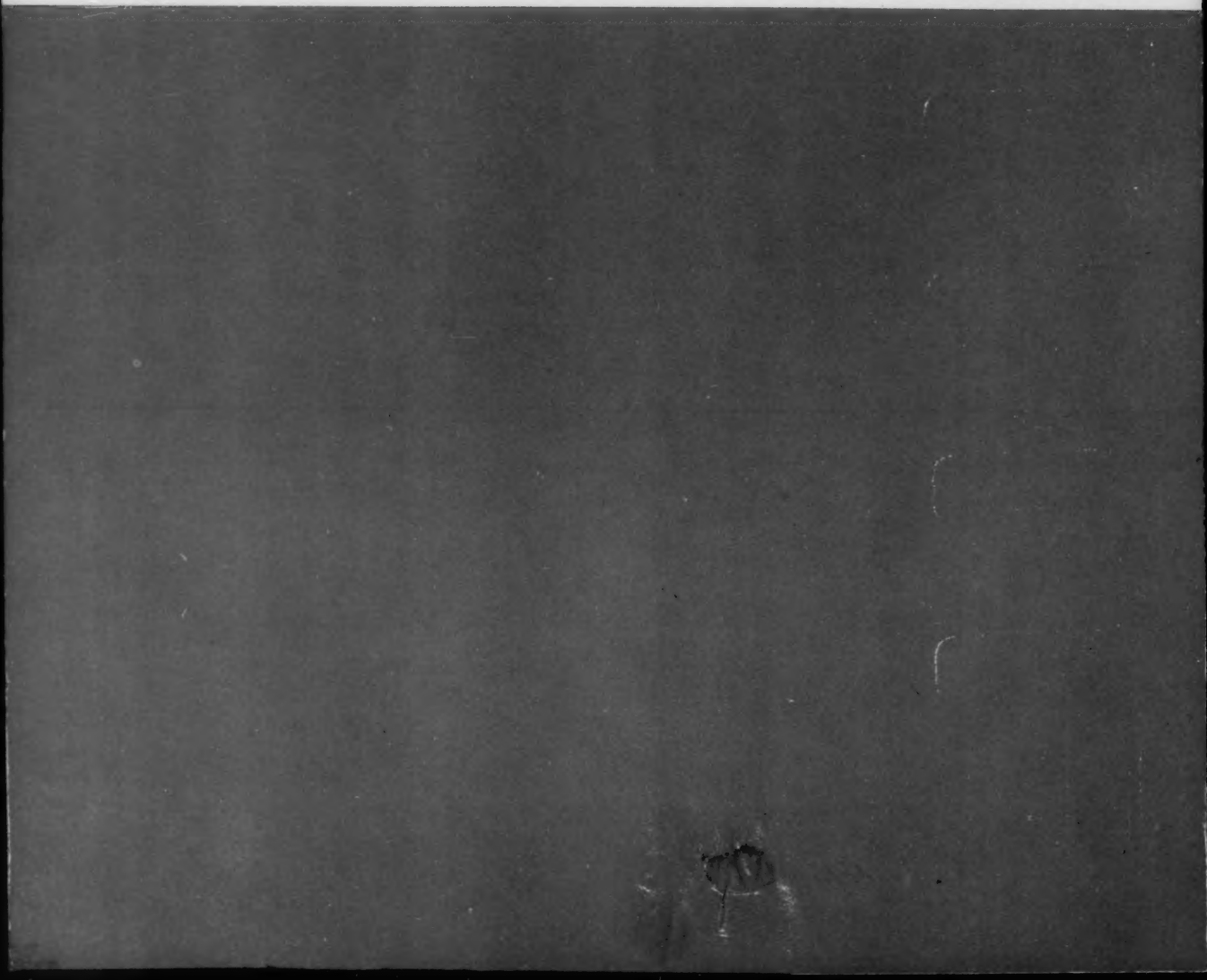
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